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# ENGINEERING TESTS FOR ENERGY STORAGE CARS AT THE TRANSPORTATION TEST CENTER
## Volume I - Program Description and Test Summary

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MAY 1977

FINAL REPORT



Prepared for

U.S. DEPARTMENT OF TRANSPORTATION
URBAN MASS TRANSPORTATION ADMINISTRATION
Office of Technology Development and Deployment
Office of Rail Technology Development
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16. Abstroct

The primary purpose of the tests documented herein was to demonstrate the principles and feasibility of an energy storage type propulsion system, and its adaptability to an existing car design. The test program comprised four phases of tests on two New York City Transit Authority R-32 cars where the conventional propulsion system was replaced by an energy storage system. The four test phases were: verification of safe arrival, debugging procedures, performance verification tests, and expanded test program. This report contains test data collected during the performance verification and expanded test program phases. Testing was conducted at the DOT Transportation Test Center, Pueblo, Colorado. The data was collected and processed in accordance with the General Vehicle Test Plan for Urban Rail Transit Cars.

Volume II, Performance, Power Consumption, and Radio Frequency Interference Tests; Volume III, Noise Tests; and Volume IV, Ride Roughness Tests.



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# PREFACE

This document describes testing conducted on the Energy Storage Car (ESC) at the Transportation Test Center, Pueblo, Colorado, by the AiResearch Manufacturing Company, Torrance, California, a division of The Garrett Corporation.

The Energy Storage System (ESS) was installed onboard two New York City Transit Authority R-32 transit cars for use as a test bed confirming ESS adaptability to rail cars, and also to demonstrate the the principles and feasibility of the concept of energy storage. AiResearch is conducting the ESC program under a contract from the Metropolitan Transportation Authority. The program is sponsored by the Urban Mass Transportation Administration (UMTA) Rail Technology Division, the Metropolitan Transportation Authority, and the State of New York.

This report is derived from the efforts of two agencies of the U.S. Department of Transportation: the Rail Programs Division of the UMTA Office of Research and Development and the Transportation Systems Center (TSC).

As Systems Manager for the Urban Rail Supporting Technology Program, Rail Programs Division, UMTA Office of Research and Development, TSC is responsible for the development and conduct of a comprehensive program of test and evaluation of vehicles, structures, and related components.

The Energy Storage Car Test Program at the Transportation Test Center (TTC) was accomplished under TSC sponsorship and guidance. Mr. G. Neat, Assistant Program Manager for Test and Evaluation, Urban Rail Supporting Technology Program, provided technical guidance as contract monitor. Also acknowledged are the efforts of key TSC personnel onsite at TTC such as Mr. R. Parker and Mr. R. Brush.

Program responsibility at AiResearch was vested in the Ground Transportation and Industrial Power Systems Department, headed by Mr. W. H. Sutton, Chief Engineer; Mr. E. E. Nickel, Program Manager; Mr. R. W. McConnell, Data Reduction; and Mr. G. McClure, Test Engineer.

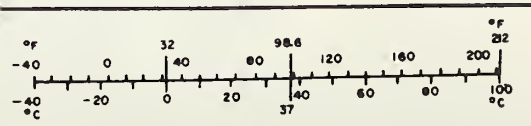
# METRIC CONVERSION FACTORS

## Approximate Conversions to Metric Measures

| Symbol | When You Know | Multiply by | To Find | Symbol |
|---|---|---|---|---|
| | | **LENGTH** | | |
| in | inches | 2.5 | centimeters | cm |
| ft | feet | 30 | centimeters | cm |
| yd | yards | 0.9 | meters | m |
| mi | miles | 1.6 | kilometers | km |
| | | **AREA** | | |
| $in^2$ | square inches | 6.5 | square centimeters | $cm^2$ |
| $ft^2$ | square feet | 0.09 | square meters | $m^2$ |
| $yd^2$ | square yards | 0.8 | square meters | $m^2$ |
| $mi^2$ | square miles | 2.6 | square kilometers | $km^2$ |
| | acres | 0.4 | hectares | ha |
| | | **MASS (weight)** | | |
| oz | ounces | 28 | grams | g |
| lb | pounds | 0.45 | kilograms | kg |
| | short tons (2000 lb) | 0.9 | tonnes | t |
| | | **VOLUME** | | |
| tsp | teaspoons | 5 | milliliters | ml |
| Tbsp | tablespoons | 15 | milliliters | ml |
| fl oz | fluid ounces | 30 | milliliters | ml |
| c | cups | 0.24 | liters | l |
| pt | pints | 0.47 | liters | l |
| qt | quarts | 0.95 | liters | l |
| gal | gallons | 3.8 | liters | l |
| $ft^3$ | cubic feet | 0.03 | cubic meters | $m^3$ |
| $yd^3$ | cubic yards | 0.76 | cubic meters | $m^3$ |
| | | **TEMPERATURE (exact)** | | |
| °F | Fahrenheit temperature | 5/9 (after subtracting 32) | Celsius temperature | °C |


## Approximate Conversions from Metric Measures

| Symbol | When You Know | Multiply by | To Find | Symbol |
|---|---|---|---|---|
| | | **LENGTH** | | |
| mm | millimeters | 0.04 | inches | in |
| cm | centimeters | 0.4 | inches | in |
| m | meters | 3.3 | feet | ft |
| m | meters | 1.1 | yards | yd |
| km | kilometers | 0.6 | miles | mi |
| | | **AREA** | | |
| $cm^2$ | square centimeters | 0.16 | square inches | $in^2$ |
| $m^2$ | square meters | 1.2 | square yards | $yd^2$ |
| $km^2$ | square kilometers | 0.4 | square miles | $mi^2$ |
| ha | hectares (10,000 $m^2$) | 2.5 | acres | |
| | | **MASS (weight)** | | |
| g | grams | 0.035 | ounces | oz |
| kg | kilograms | 2.2 | pounds | lb |
| t | tonnes (1000 kg) | 1.1 | short tons | |
| | | **VOLUME** | | |
| ml | milliliters | 0.03 | fluid ounces | fl oz |
| l | liters | 2.1 | pints | pt |
| l | liters | 1.06 | quarts | qt |
| l | liters | 0.26 | gallons | gal |
| $m^3$ | cubic meters | 35 | cubic feet | $ft^3$ |
| $m^3$ | cubic meters | 1.3 | cubic yards | $yd^3$ |
| | | **TEMPERATURE (exact)** | | |
| °C | Celsius temperature | 9/5 (then add 32) | Fahrenheit temperature | °F |



CONTENTS

# ILLUSTRATIONS

# 1. INTRODUCTION

## 1.1 GENERAL

The AiResearch Manufacturing Company prepared this report for the Transportation Systems Center of the Department of Transportation. It covers energy storage car (ESC) tests performed by AiResearch from May 1974 through January 1975 at the Transportation Test Center, Pueblo, Colorado. (See Figure 1-1.

The report consists of four volumes.

| | |
|---|---|
| Volume I | Program Description and Test Summary |
| Volume II | Performance, Power Consumption, and Radio Frequency Interference Tests |
| Volume III | Noise Tests |
| Volume IV | Ride Roughness Tests |

All tests reported herein were conducted in accordance with the procedures defined in the TSC General Vehicle Test Plan, GSP-064[1] (draft version), 21 May 1974. These test procedures are delineated in AiResearch documents 73-9373 (Energy Storage Cars Test Program) and 74-10441 (Expanded Testing on Energy Storage Cars).

The vast amount of data recorded during these tests is stored on magnetic analog tape and will contribute to UMTA's growing data bank for urban rail vehicles.

## 1.2 TEST CRITERIA

The objectives of the tests were:

Verification of system performance

Confirmation of system adaptability to rail cars

Evaluation of system noise (exterior, interior)

Evaluation of system ride roughness

Evaluation of system structural dynamics

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[1] This document has since been formally published as General Vehicle Plan (GVTP) for Urban Rail Transit Cars, September 1976 (Report No. UMTA-MA-0025-75-14) PB251-086.

Figure 1-1. Energy Storage Car at Transportation Test Center

## 1.3 SYSTEM DESCRIPTION

The energy storage system (ESC) developed by AiResearch uses two motor-driven flywheel assemblies per car to supply electrical energy to the separately excited traction motors for car acceleration. During car deceleration (braking), the electrical energy from the traction motors (now generators) is returned to the flywheel motors, increasing flywheel speed. The makeup electrical energy required is supplied to the traction and flywheel systems by a solid-state dc chopper, which is regulated to draw only an average amount of power during normal accleration and deceleration. The primary advantages of an energy storage system are:

Reduced energy consumption

Reduced peak power from substations

Reduced tunnel heating due to less need for dynamic braking

The ESC is mounted onboard an R-32 transit car. This car, first built in 1964, was originally powered by series traction motors and a camshaft controller. The energy storage car conversion was accomplished at the AiResearch facilities, Torrance, California. The energy storage unit is shown in Figure 1-2.

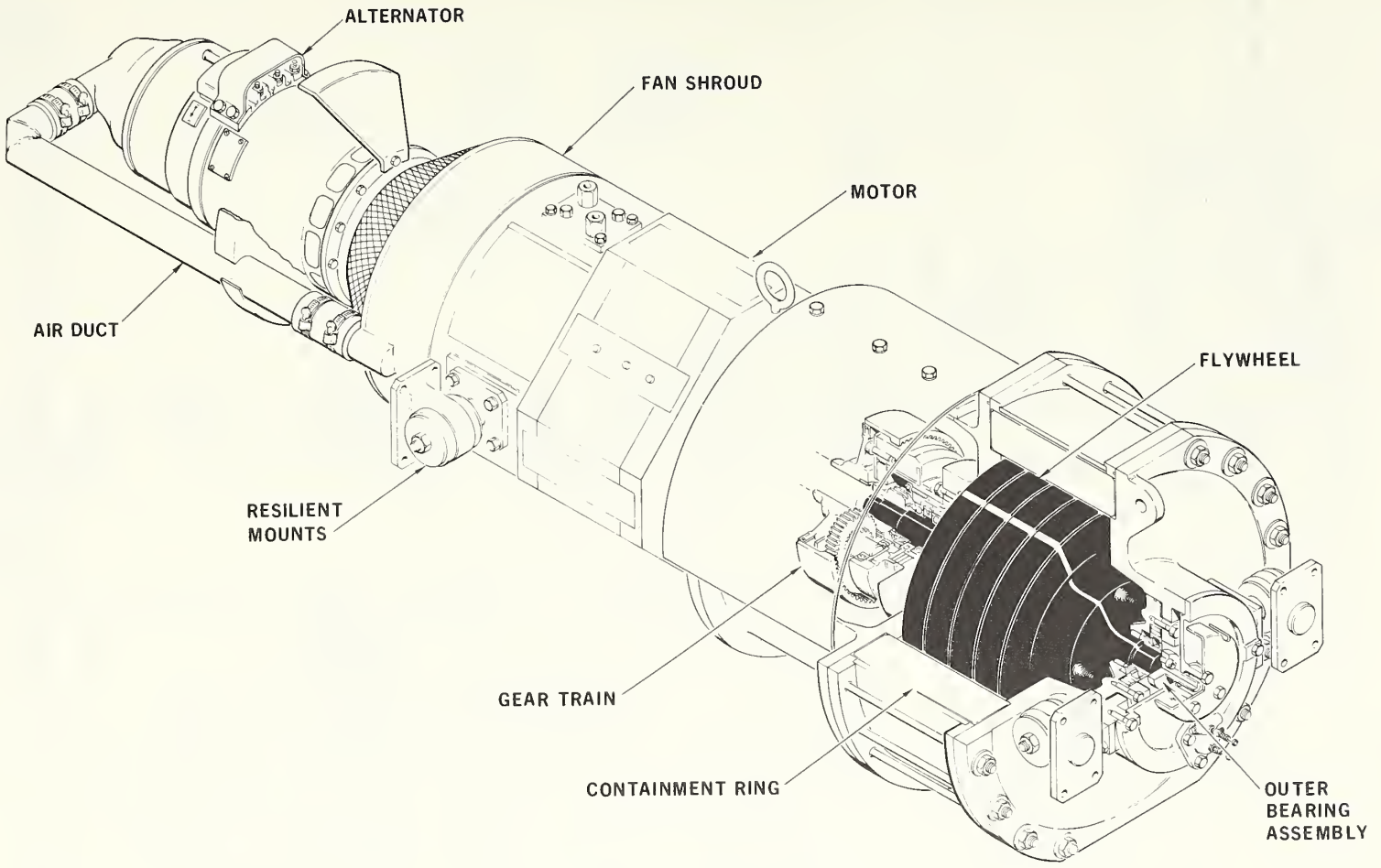



Figure 1-2. Energy Storage Unit

### 1.3.1 CAR WEIGHT

Definition for car weight abbreviation description is as follows:

(a) AW0--Empty weight: car 3700, 42.5 tons (including instrumentation estimated at 1.35 tons); car 3701, 41.4 tons

(b) AW2--Full load (AW0 + 15.4 tons)

(c) AW3--Crush load (AW0 + 21 tons)

### 1.3.2 EQUIPMENT LIST AND INTERFACE DETAILS

The major system components are listed in Table 1-1.

Table 1-1. Energy Storage System Components

| Component | AiResearch Part No. | Qty per Car |
|---|---|---|
| Motor/flywheel unit | 543122-1 | 1 |
| Motor/flywheel unit | 543122-2 | 1 |
| Traction motor | 2000756-1 | 4 |
| Chopper | 2001000-1 | 1 |
| Smoothing inductor | 542551 | 1 |
| Input inductor | 542553 | 1 |
| Propulsion control | 2000997-1 | 1 |
| Power control unit | 542540 | 1 |
| Auxiliary control unit<br>Flywheel field supply<br>Traction field supply<br>Alternator regulator | 542542<br>2015368<br>2015367<br>NA | 1 |
| Brake resistor | NA | 2 |
| Air duct assembly<br>Air duct filter<br>Cooling fan | 523050 | |
| System instrument panel | 543121 | 1 |

Figure 1-3 is a simplified circuit schematic that shows major system interfaces for a single-car system.

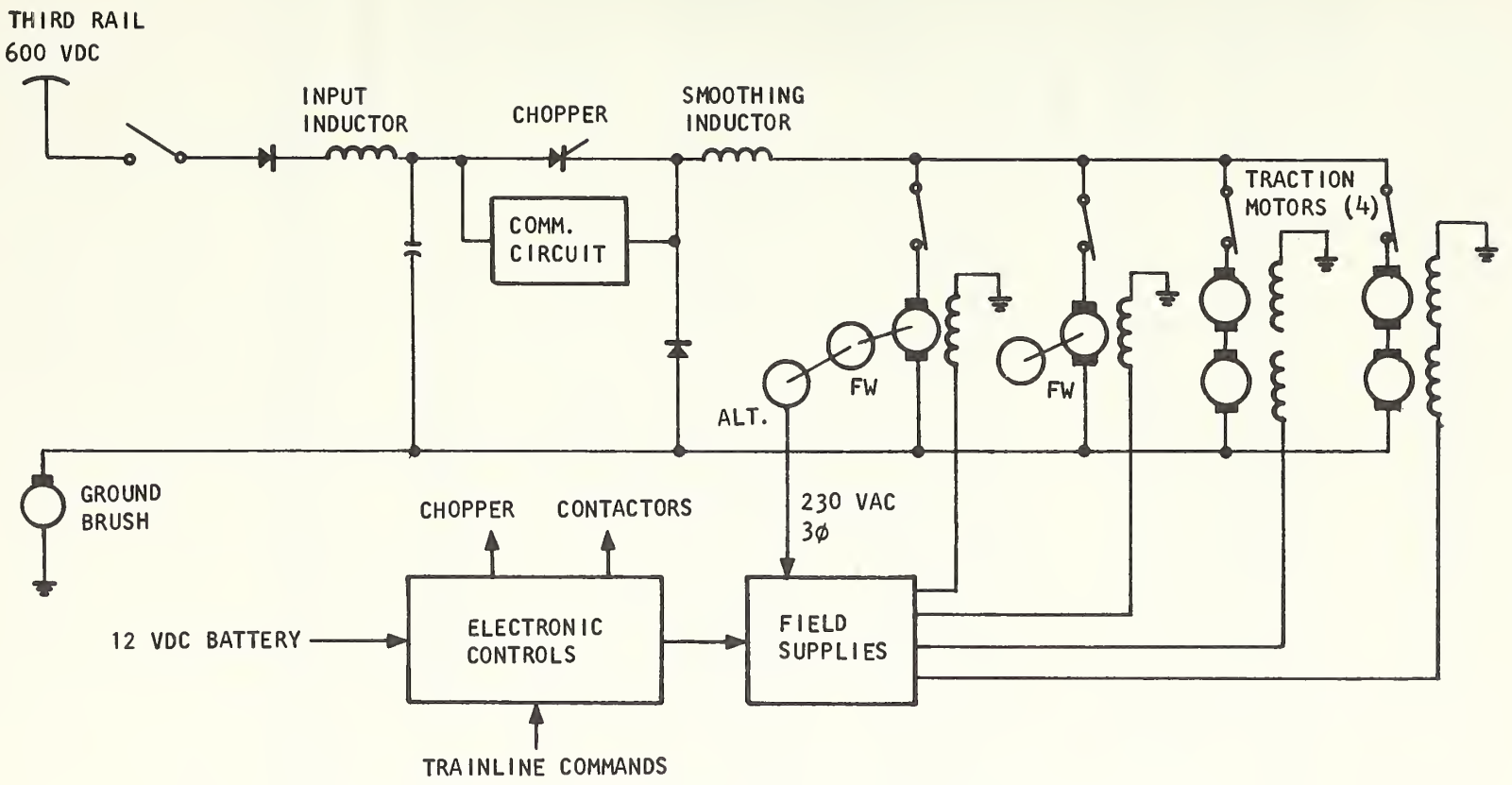



Figure 1-3. Energy Storage System Simplified Circuit Schematic

# 2. TEST DESCRIPTION

## 2.1 FACILITY

Energy storage car testing was accomplished at the Transportation Test Center (TTC), Pueblo, Colorado. Actual running of the ESC was performed on the UMTA test track under existing environmental conditions.

The UMTA test track is a 9.1-mile, nearly oval loop embodying six different types of construction. Track layout and construction are shown in Figure 2-1 and the track profile in Figure 2-2.

## 2.2 INSTRUMENTATION

The vehicle was instrumented to record data on magnetic tape for future retrieval and on an oscillograph for quick-look monitoring of selected parameters. In addition, system component temperatures were recorded on a strip chart recorder for a limited number of test conditions. System input power was integrated on a digital readout to provide kilowatt-hour data for power consumption runs. Figure 2-3 is a block diagram of the onboard data acquisition system. (Refer to Table 2-1 for details.)

Retrieval of taped data was usually accomplished by playback on an eight-channel recorder in the manner shown in Figure 2-4. (Refer to Table 2-2 for details.) Data reduction was then carried out using the analog information provided from these playbacks. In some cases (e.g., power consumption) data was manually tabulated directly from the digital readouts.

The bandwidth resolution and sensitivity ranges of the recording equipment and the sensors are summarized in Table 2-3.

An example of the parameters recorded and the instrumentation used for the performance tests is shown in Table 2-4.

Other volumes of this report include block diagrams of instrumentation related to individual parameters when additional details are required.

## 2.3 PROCEDURES

ESC test procedures are described in TSC General Vehicle Test Plan, GSP-064. Detailed requirements for these tests are covered in AiResearch documents 73-9373 and 74-10441.

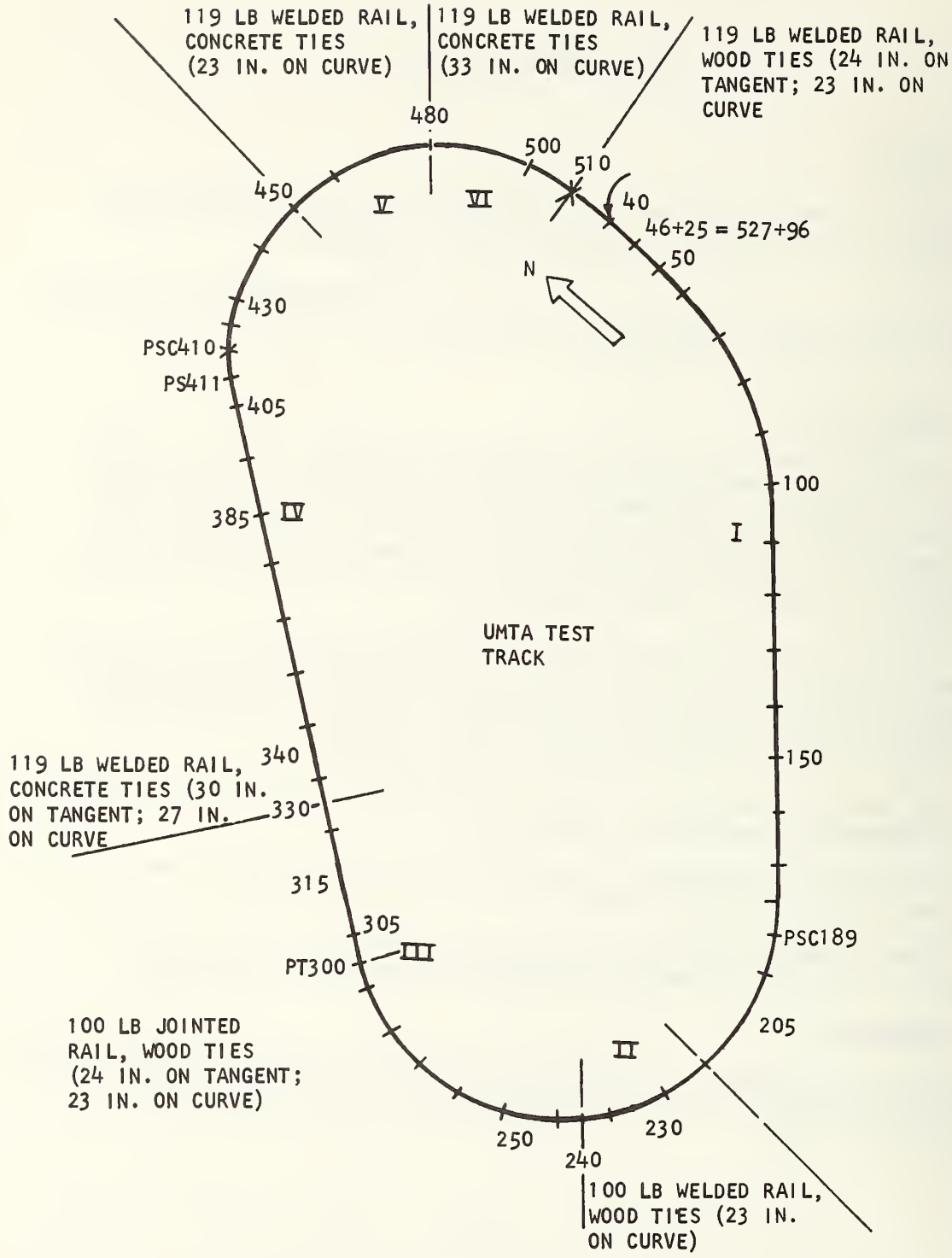



Figure 2-1. Rail Transit Test Track Layout

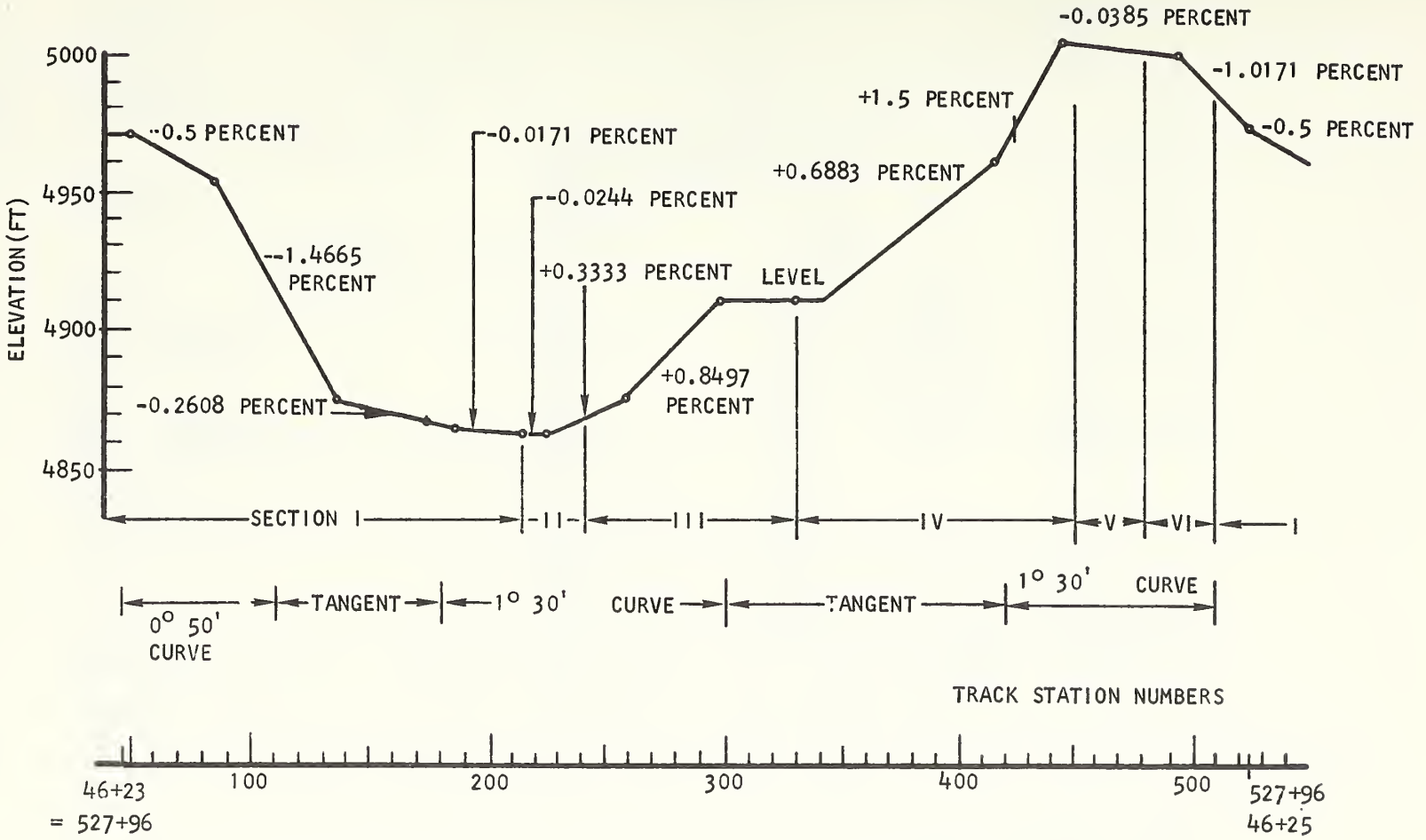



Figure 2-2. Nominal Track Profile

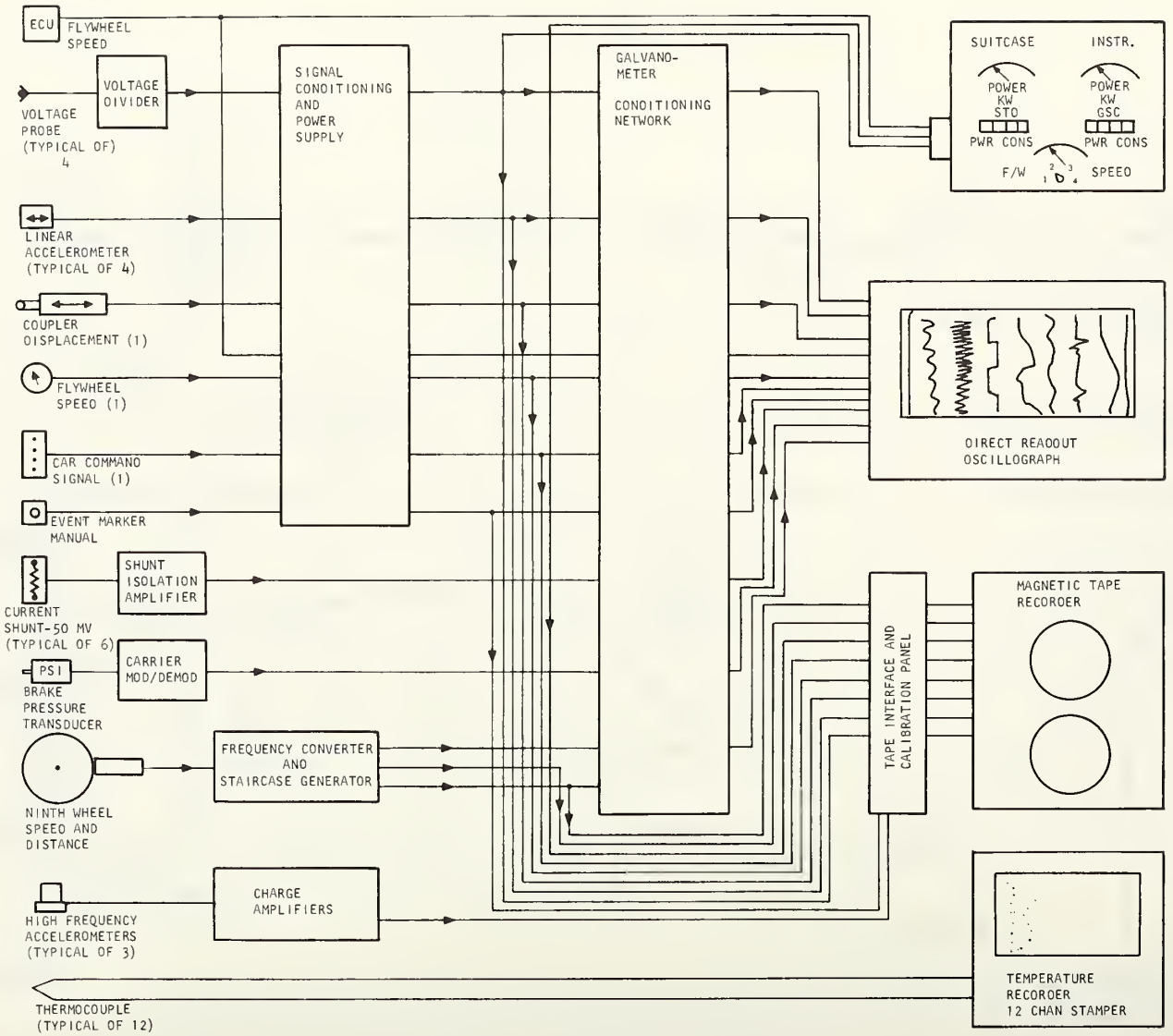



Figure 2-3. Data Acquisition System

Table 2-1. Data Acquisition System Instrumentation

| Item No. | ESC Instrumentation Description | Model No. | Mfg. | Response Range | Sensitivity | Calib. | Notes |
|---|---|---|---|---|---|---|---|
| 1 | Oscillograph Recorder (36 Chan.) | 5-119 | Bell & Howell | 0 to 500 Hz | ≈ 2.5 v per in. | 0 to 2 in. for F.S. signal | |
| 2 | Oscillograph Recorder (12 Chan.) | 5-124 | Bell & Howell | 0 to 500 Hz | ≈ 2.5 v per in. | 0 to 2 in. for F.S. signal | |
| 3 | Multipoint Temperature Recorder (12 Chan.) | Speedomax "H" | Leeds & Northrop | N.A. | ≈ 50°F per in. | 0 to 1200°F (Type E Sensor) | |
| 4 | Tape Recorder | 2114 | Precision Instruments | 0 to 10 kHz | ≈ 10 mv minimum | ±5 v F.S. signal | |
| 5 | Strain Gage Signal Conditioning | LSK 36398 | AiResearch | 0 to 10 kHz | ≈ 10 με minimum | Depends on Sensor | |
| 6 | General Signal Conditioning | LSK 36052 | AiResearch | 0 to 500 Hz | N.A. | ±5 v F.S. signal | Provides buffering for voltages and accels. |
| 7 | Accelerometer Charge Amplifiers | D11 | Unholtz Dickie | 0 to 10 kHz | 1g to 1000g F.S. | 5 v = 3g | |
| 8 | Speed & Distance Signal Conditioning | LSK 36220 & LSK 36054 | AiResearch | 0 to 1 kHz | ≈ ±0.1 mph & ≈ ±1.0 ft. | 0 to 50 mph - | |

Table 2-1. Data Acquisition System Instrumentation (Continued)

| Item No. | ESC Instrumentation Description | Model No. | Mfg. | Response Range | Sensitivity | Calib. | Notes |
|---|---|---|---|---|---|---|---|
| 9 | Charge Accelerometers | 2272 | Endevco | 0 to 5 kHz | ≈ .01 g minimum | AiResearch Certified | |
| 10 | Linear Accelerometers | LSBC 39-2 | Schaevitz | 0 to 40 Hz | ≈ .001 g minimum | 5 v = 2 g | |
| 11 | Current Shunts | PR1000 | Quality Electric | 0 to 500 Hz | ≈ 0.1 mv minimum | 50 mv = 1000A | |
| 12 | Current Shunt Isolators | 6271A | Scientific Columbus | 0 to 120 Hz | ≈ 0.5% of F.S. | 50 mv = 5v | |
| 13 | Voltage Dividers | - | AiResearch | 0 to 1 kHz | ≈ 0.5 v minimum | 750 v = 9 v | 0.1% Resistive Divider |
| 14 | Calibration Power Supply | LS513 | Lambda | 0 to 40 v | 100 μv | AiResearch Certified | |
| 15 | Calibration Frequency Counter | CF601R | Anadex | 1 Hz to 99,999 Hz | ±1 count | AiResearch Certified | |
| 16 | Calibration Oscillator | 204C | Hewlett Packard | 5 Hz to 1.2 mHz | ±1% | AiResearch Certified | |
| 17 | Calibration RMS Voltmeter | 427A | Hewlett Packard | 0.01 v to 300 v 10 Hz to 1 mHz | ≈ 0.5 mv minimum | AiResearch Certified | |
| 18 | Calibration DC Voltmeter | DS100 | Doric | 0 to 1000 v | 0.1 mv | AiResearch Certified | |
| 19 | Inverter | 1000 GCCWD | Topaz | DC to 60 Hz | N.A. | N.A. | |

Table 2-1. Data Acquisition System Instrumentation (Continued)

| Item No. | ESC Instrumentation Description | Model No. | Mfg. | Response Range | Sensitivity | Calib. | Notes |
|---|---|---|---|---|---|---|---|
| 20 | Oscilloscope | 503 | Tektronix | DC to 1 mHz | 10 mv minimum | AiResearch Certified | |
| 21 | Coupler Displacement | WR8 | Lockhead Electronics | DC to 50 Hz | ≈ 1.0 v per in. | 5 in. F.S. | |
| 22 | Kilowatt Hour Meter | LSK 36129 | AiResearch | 0 to 99,999.9 KWHR | 0.1 KWHR | 1.5 MEGA Watt F.S. | |

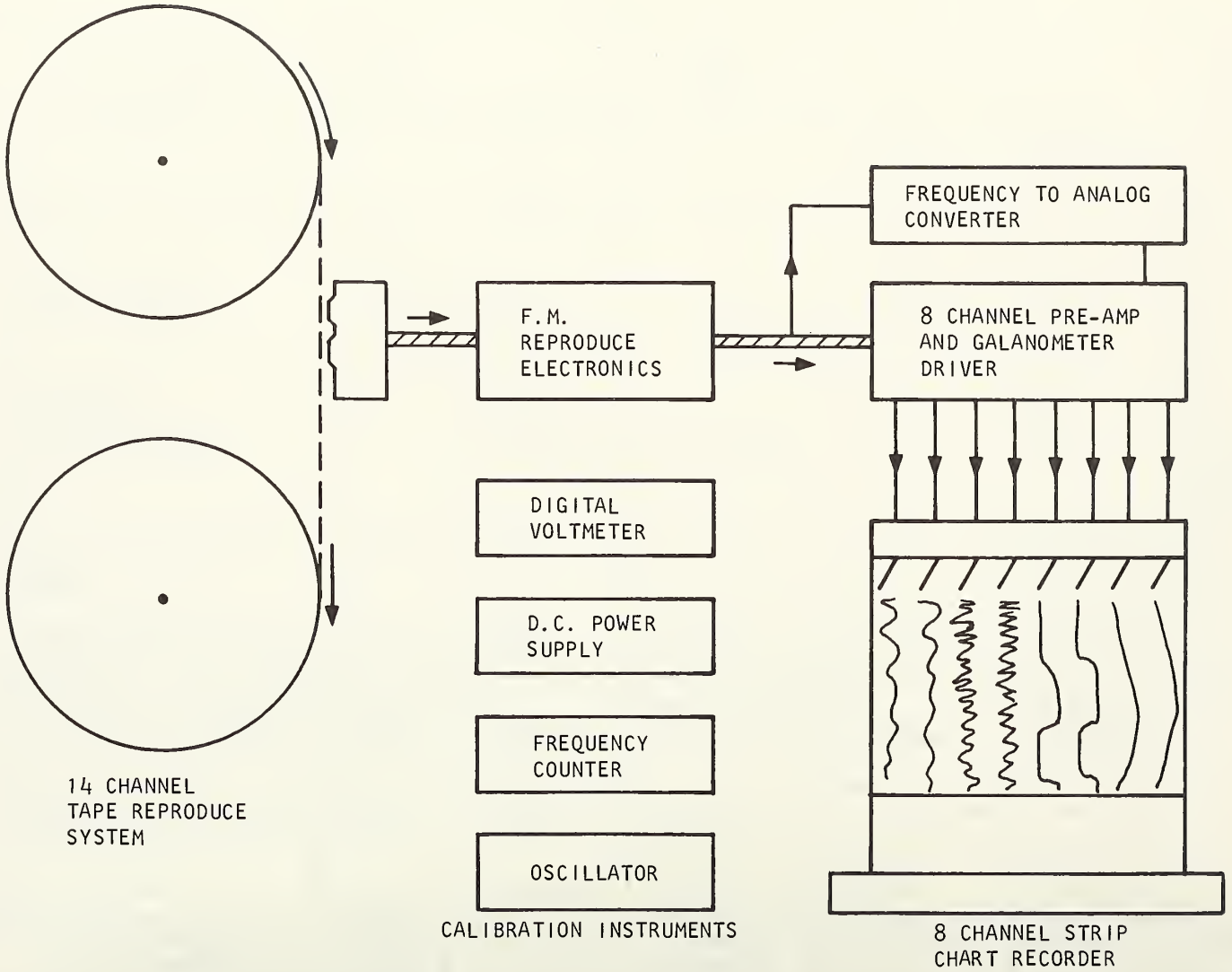



Figure 2-4. Data Recovery System

Table 2-2. Data Recovery System Instrumentation

| Item | Instrument | Model | Sensitivity | Range | Description |
|---|---|---|---|---|---|
| 1 | Magnetic Tape Recorder/Reproducer | Honeywell No. 7600 | 0.5 to 10 v peak for full deviation | 3-3/4 ips - 0 to 625 Hz<br>7-1/2 ips - 0 to 1250 Hz<br>15 ips - 0 to 2500 Hz | 14-channel FM reproduce medium band system. |
| 2 | Strip Chart Recorder | Beckman-Offner Typer Dynograph | 1.0 mv/mm max. | 0 - 200 Hz ±20% | 8-channel direct writing oscillograph |
| 3 | Digital Volt Meter | Doric-DS 100 | 0.1 mv to 1000v | - | Dc voltmeter |
| 4 | DC Power Supply | Lambda LS 513 | 100 μv to 40v | - | Precision, programmable, digital adjust |
| 5 | Frequency Counter | Anadex CF601R | ±1 count | 1 Hz to 99.999 kHz | Digital Counter |
| 6 | Oscillator | Hewlett-Packard 204B | ±1% of scale | 5 Hz to 560 kHz | Solid state, battery-operated |
| 7 | Frequency | Anadex P1-408R | 0.01v RMS threshold voltage | 5 Hz to 51.2 kHz | Frequency to analog converter with zero suppression |

Table 2-3. Parameter Calibration Ranges

| Parameter | Calibration Range | Calibration |
|---|---|---|
| Voltages | 1000 v = F.S. (750 v = 9.000 v) | Resistive Divider (0.01% Resistors)<br>Lambda Power Supply and Doric Voltmeter |
| Currents | 1000 A = 50 mv - 5 v | Certified Current Shunt<br>Lambda Power Supply and Doric Voltmeter |
| Linear Accelerometers | ±0.5 g = ±5 v | Calibrated Accelerometer<br>Lambda Power Supply and Doric Voltmeter |
| Speed | 0 to 50 mph | H.P. Oscillator and Anadex Counter |
| Charge Accelerometers | ± 3 g | Calibrated Accelerometer<br>H.P. Oscillator and H.P. RMS Voltmeter |
| Temperature Recorder | 0 to 1200 $^{0}$F<br>Type E Thermocouple | Ice Bath Reference<br>Lambda Power Supply and Doric Voltmeter |
| Oscillograph Recorders | 5 v = 2 in. | H.P. Oscillator & H.P. RMS Voltmeter or<br>Lambda Power Supply and Doric Voltmeter |
| Tape Recorder | ±5 v = F.S. (±40% deviation on FM) | Lambda Power Supply and Doric Voltmeter |

Total power consumption for the entire instrumentation system is ≈ 1.5 kw.

## Table 2-4. Performance Test Parameters and Instrumentation

| Recorded Parameter | Accel Tests | Decel Tests (Blended) | Decel Tests (Friction) | Drift Tests | Duty Cycle Tests | Power Consumption Tests | Misc. |
|---|---|---|---|---|---|---|---|
| Event and Time Mark | O T | O T | O T | O T | O T | O T | |
| Volts, 3rd Rail | O T | O T | O T | O | O | O T | |
| Volts, Capacitor Bank | | | | O | O | | |
| Volts, Flywheel Mtr. A | O T | O T | O T | O | O T | O | |
| Volts, Trac. Mtr. A | O | O | O | O T | O T | O T | |
| Current, 3rd Rail 3700 | O T | O T | O T | O | O | O | |
| Current, 3rd Rail 3701 | O | O | O | O | O | O T | |
| Current, Trac. Mtr. A | O(A)T | O(A)T | O(A)T | O(A)T | O(A)T | O T | |
| Current, Trac. Mtr. B | | | | O(B) | O(B) | | |
| Current, Flywheel Mtr. A | O(A)T | O(A)T | O(A)T | O(A)T | O(A)T | O T | |
| Current, Flywheel Mtr. B | | | | O(B) | O(B) | | |
| Vibration, Carbody Vert. | | | | O | O | | |
| Vibration, Carbody Lat. | | | | O | O | | |
| Vibration, Carbody Long. | | | | | | | |
| Vibration, Flywheel Vert. | | | | T | | | |
| Vibration, Flywheel Lat. | | | | T | | | |
| Vibration, Flywheel Long. | | | | | | | |
| Acceleration, Vehicle Long. | O T | O T | O T | O T | O T | O T | |
| Displacement, Coupler | | | | O | O | O | |
| Car Command Signal | O T | O T | O T | O T | O T | O T | |
| Distance, Vehicle | O T | O T | O T | O T | O T | O T | |
| Speed, Vehicle | O T | O T | O T | O T | O T | O T | |
| Speed, Flywheel A | O T | O T | O T | O T | O T | O T | |
| Lock-out Magnet | O T | O T | O T | O | O T | | |
| Pressure, Brake Cylinder | O | O | O | O T | O T | | |
| Voice | T | T | T | T | T | T | |
| Temperature Wheel, Brake Shoe | S | S | | | S | | |
| Temperature Vehicle Components | | | | | | | S |

NOTE: T = Recorded on Magnetic Tape
O = Recorded on Oscillograph Paper
S = Recorded on Strip-Chart Temperature Stamper
(A) Car 3700
(B) Car 3701

TEST ORDER

Test effort at the TTC was conducted in the following sequence:

| | | |
|---|---|---|
| (a) | Verification of safe arrival | AiResearch Document 73-9373 (Tests planned prior to Contract DOT-TSC-838.) |
| (b) | Debugging procedure | |
| (c) | Performance verification tests | |
| (d) | Expanded test program | AiResearch Document 74-10441 (Tests added for Contract DOT-TSC-838.) |

Only the tests in categories c and d are reported herein.

## 2.4 TEST DESCRIPTION AND RESULTS

### 2.4.1 VERIFICATION OF SAFE ARRIVAL

Upon arrival at the TTC the ESC were subjected to a thorough preliminary checkout and processing by representatives of AiResearch and NYCTA. Particular attention was given to the newly installed equipment and wiring.

The checkout included a thorough functional examination of the mechanical and electrical devices and their controls. The air brake system was functionally tested per NYCTA Car Setup Procedures. Miscellaneous auxilliary equipment and the propulsion system were also functionally checked out, followed by a car clearance check that consisted of towing the cars on a track equipped with a third rail to confirm proper alignment of the third rail shoe. The clearance check was performed on both the tangent and minimum radius track for the third rail shoe and other external car-mounted equipment.

The run logs included herein in Appendix C, provide a record of the sequence of events. Test results in each category are compiled by test set, not necessarily in chronological order. The order of testing was selected to assure efficient scheduling and to minimize the shifting of ballast.

### 2.4.2 DEBUGGING OPERATIONS (FOUR-CAR TRAIN)

Initial operation was conducted to functionally check out the car's control system by verifying the stability of a four-car system (two ESC's coupled to two R-42 cars) under AWO conditions (empty weight) throughout the ESC's speed regime. Compatibility testing of the ESC vehicles was conducted at Pueblo with the R-42 cars because they were available. The R-42 vehicles are trainline-compatible with the original R-32 cars and are similar in size and performance characteristics. Calibration and trimming of the controls were also performed during the debugging operation. A copy of the log for the trainline test is included in Appendix C, run 32.

All runs from the initial run through run 31 were conducted for the purpose of thoroughly checking the ESS and its associated instrumentation for proper operation and integrity; also, these runs were utilized to familarize the car operator with the ESS operation and handling characteristics. The logs and all data recorded during the first 31 runs were not relevant to the test program. Therefore, they are not included herein.

### 2.4.3 PERFORMANCE VERIFICATION TESTS

The following verification tests (refer to Table 2-5) were conducted in accordance with the procedures described in AiResearch Proposed Test Program, document 73-9373 and Expanded Testing, document 74-10441, on two R-32 cars (3700 and 3701) converted to energy storage cars.

NOTE

Instrumentation for these tests is listed in Table 2-1.

### 2.4.4 FAILURE MODES AND SAFETY DEMONSTRATION

Cars 3700 and 3701 demonstrated safe ESS response when various fault sensors and critical control signals were actuated or interrupted. Initially, the condition of both cars was established at (1) zero speed on energized third rail, (2) flywheels operating at steady-state speed, and (3) controls in the OFF position. Thereupon, the transient conditions of AiResearch document 75-9373, were introduced.

### 2.4.5 RESULTS

All safety features of both cars performed successfully. The QSD and safety devices operated as specified for the respective design application. Both cars were given a safety clearance to continue testing. Refer to test log 32, Appendix C.

## 2.5 TEST SETS

Each of the 21 ESC test sets listed in Table 2-5 incorporates a test objective, description, procedure, and a definition of instrumentation and data processing requirements. The information that makes up the test set is defined in General Vehicle Test Plan, GSP-064. This same information, along with the processed data and discussion of the results are packaged together to form a compact sub-report of each test set.

The other volumes of this report each include the test sets applicable to the subject matter covered by that specific volume. Each test set is preceded by a summary sheet which includes the test set number, title, objective, description, and status of results. Summary sheets for the performance, power consumption, and radio frequency interference tests are provided in Volume II; noise test summary sheets, in Volume III; and ride roughness summary sheets in Volume IV. To provide and overview of the ESC test results, all of the summary sheets are presented in Appendix B of this volume.

Table 2-5. Test List

| Para No. | Test Area | Test Title | Test Procedure Reference* | | |
|---|---|---|---|---|---|
| | | | GSP-064 (Set No.) | AiR 73-9373 (Para No.) | AiR 74-10441 (Page No.) |
| 2.5.1 | Performance | Acceleration | P-2001-TT | 4.4.7.3 | 3 |
| 2.5.2 | | Deceleration - Blended Braking | P-3001-TT | 4.4.7.4 | 4 |
| 2.5.3 | | Deceleration - Service Friction | P-3002-TT | -- | 4 |
| 2.5.4 | | Traction Resistance (Drift) | P-4001-TT | 4.4.7.2 | 5 |
| 2.5.5 | | Friction Brake - Duty Cycles | P-5001-TT | -- | 5 |
| 2.5.6 | Power Consumption | Power Consumption | PC-5011-TT | 4.4.7.11 | - |
| 2.5.7 | Radio Freq Interference | Radio Frequency Interference | PSI-6001-TT | -- | 11 |
| 2.5.8 | Exterior Noise | Equipment Noise Survey-Wayside | CN-0001-TT | 4.4.7.7 | 7 |
| 2.5.9 | | Effect of Car Speed-Wayside | CN-1001-TT | 4.4.7.7 | - |
| 2.5.10 | Interior Noise | Effect of Speed-On Car | PN-1001-TT | 4.4.7.8 | - |
| 2.5.11 | | Effect of Track Section-On Car | PN-1101-TT | -- | 8 |
| 2.5.12 | | Interior Noise Survey | PN-1301-TT | 4.4.7.8 | 8 |
| 2.5.13 | | Acceleration Effect-On Car | PN-2001-TT | 4.4.7.8 | 9 |
| 2.5.14 | | Deceleration Effect-On Car | PN-3001-TT | 4.4.7.8 | 9 |
| 2.5.15 | Ride Roughness | Dynamic Shake Test-Vertical | R-0001-XX | -- | 9 |
| 2.5.16 | | Dynamic Shake Test-Lateral | R-0002-XX | -- | 9 |
| 2.5.17 | | Dynamic Shake Test-Longitudinal | R-0003-XX | -- | 10 |
| 2.5.18 | | Component Induced Vibration | R-0010-TT | 4.4.7.8 | 10 |
| 2.5.19 | | Worst Speeds | R-1101-TT | -- | 10 |
| 2.5.20 | | Acceleration | R-2001-TT | -- | 10 |
| 2.5.21 | | Deceleration | R-3001-TT | -- | 10 |

*TSC General Vehicle Test Plan, GSP-064
AiResearch Proposed Test Program for Energy Storage Cars, 73-9373
AiResearch Expanded Testing on Energy Storage Cars, 74-10441

A brief outline of the GSP-064 test sets used in the energy storage car test program are provided in paragraphs 2.5.1 through 2.5.21.

2.5.1 ACCELERATION - ESC-P-2001-TT

2.5.1.1 Objective

To determine the overall acceleration characteristics of the test vehicle as affected by controller input level, line voltage, car weight (load weighting), car direction, and train consist.

2.5.1.2 Description

The test vehicle was acclerated at the required controller command on level tangent track. The following combinations can be tested:

| Procedure Option | Prime Variable | Test Conditions |
|---|---|---|
| (4) | Controller level | Half and full power |
| (6) | Line voltage | Min, 600, & max. volts |
| (5) | Car weights | AW0, AW2 and AW2 |
| (3) | Car direction | Forward and reverse |
| (7) | Train consists | 2-car train |

2.5.1.3 Procedure

The tests were performed in accordance with procedures described in AiResearch documents 73-9373 and 74-10441 in conformance with Test Set Number ESC-P-2001-TT of TSC General Vehicle Test Plan GSP-064.

2.5.1.4 Results

The cars completed the acceleration tests successfully. A copy of the log for test runs 49 and 55 are included in Appendix C. Details and data reduced from tapes recorded during these tests are presented in Volume II.

2.5.2 BLENDED BRAKING DECELERATION - ESC-P-3001-TT

2.5.2.1 Objective

To determine the overall deceleration characteristics of the test vechicle utilizing the blended braking system as affected by controller input level, line voltage, car weight (load weighting), car direction, and train consist. Regeneration capability will be tested at varying line load.

2.5.2.2 Description

The test vehicle was decelerated at the required controller command on level tangent track. The following test combinations can be tested:

| Procedure Option | Prime Variable | Test Conditions |
|---|---|---|
| (5) | Controller level | Half and full brake |
| (6) | Car weights | AW0, AW2, AW3 |
| (7) | Line voltage | Min, 600, & max. volts |
| (8) | Train consists | 2-car train |
| (4) | Car direction | Forward and reverse |
| (10) | Regeneration (Load) | 100% and 50% line receptivity |

2.5.2.3 Procedure

Cars 3700 and 3701, under AW0, AW2 and AW3 conditions were subjected to deceleration tests in accordance with procedures described in AiResearch documents 73-9373 and 74-10441 in conformance with Test Set Number ESC-P-3001 of TSC General Vehicle Test Plan GSP-064.

2.5.2.4 Results

The cars completed the blended braking deceleration tests successfully. A copy of the log for test runs 55 and 76 are included in Appendix C. Details and data reduced from tapes recorded during these tests are presented in Volume II.

2.5.3 SERVICE FRICTION DECELERATION - ESC-P-3002-TT

2.5.3.1 Objective

To determine the overall deceleration characteristics of the test vehicle utilizing the friction braking only system as affected by controller input level, car weight (load weighting), car direction, and train consist.

2.5.3.2 Description

The test vehicle was decelerated at the required controller command on level tagent track. The following test combinations can be tested:

| Procedure Option | Prime Variable | Test Conditions |
|---|---|---|
| (5) | Controller level | Half and full brake |
| (6) | Car weights | AW0, AW2, AW3 |
| (7) | Train consists | 2-car train |
| (4) | Car direction | Forward and reverse |

2.5.3.3 Procedure

Cars 3700 and 3701 under AW0, AW2 and AW3 conditions were subjected to deceleration tests contained in AiResearch document 74-10441 in conformance with Test Set Number ESC-P-3002-TT of TSC General Vehicle Test Plan GSP-064.

2.5.3.4 Results

Runs 1 through 8 of the service friction deceleration tests were successfully completed. During run No. 9, a QSD was initiated due to a fault in car 3700, flywheel No. 1 Testing was discontinued for approximately the next four weeks while both cars were subjected to a thorough checkout under AW0 conditions.

A copy of the log for test runs 54, 55, 67, and 76 are included in Appendix C. Details and data reduced from tapes recorded during these tests are presented in Volume II. Runs 56 through 66 were conducted to check out the ESS and its associated hardware and were not considered germaine to test results, therefore, data and log sheets for runs 56 through 66 are not included herein.

2.5.4 TRACTION RESISTANCE (DRIFT) - ESC-P-4001-TT

2.5.4.1 Objective

To determine the traction (train) resistance of the test vehicle for use in the analysis of adhesion test data, to check the coefficients used to calculate the design performance of the vehicle, and as a baseline for analysis of the vehicle tractive and braking effort values.

2.5.4.2 Description

During the drift tests the test consist was allowed to coast from an initial speed on level tangent track. Both propulsion and friction brake

were disabled to attain a true coast. The speed-time-distance data is the source of the final resistance values.

| Procedure Option | Prime Variable | Test Conditions |
|---|---|---|
| (2) | Car weight | AW0 and AW2 |
| (3) | Train consist | 2-car train |

2.5.4.3 Procedure

Cars 3700 and 3701 under AW0 conditions were subjected to the drift test contained in AiResearch documents 73-9373 and 74-10441 in conformance with Test Set Number ESC-P-4001-TT of TSC General Vehicle Test Plan GSP-064.

2.5.4.4 Results

The cars completed the drift tests successfully. A copy of the log for test runs 34, 71, and 74 are included in Appendix C. Details and data reduced from tapes recorded during these tests are presented in Volume II.

2.5.5 FRICTION BRAKE DUTY CYCLES - ESC-P-5001-TT

2.5.5.1 Objective

To determine the thermal capacity of the vechicle's friction braking system during a sample service run. The dynamic brake system will be inoperative during the tests with the friction brake providing all of the decelerating force, as applicable.

2.5.5.2 Description

The test vehicle was accelerated to a target cruise speed, cruised for a defined time, then brake was applied to a simulated station stop. Following a defined station dwell the cycle was repeated.

| Procedure Option | Prime Variable | Test Conditions |
|---|---|---|
| (1) | Cruise speed and time | 35 mph for 45 sec.<br>50 mph for 55 sec. |
| (2) | Car weight | AW2 (or AW3) |
| (3) | Brake type | Solid wheels |
| (5) | Brake blending | Blended & friction only |

2.5.5.3 Procedure

Cars 3700 and 3701 under AW2 conditions were subjected to the friction brake duty cycle test contained in AiResearch document 74-10441 in conformance with Test Set Number ESC-P-5001-TT of TSC General Vehcile Test Plan GSP-064.

2.5.5.4 Results

The cars successfully completed the friction brake duty cycle tests. A copy of the log for test runs 77 and 81 are included ir Appendix C. Details and data reduced from tapes recorded during these tests are presented in Volume II.

2.5.6 POWER CONSUMPTION - ESC-PC-5011-TT

2.5.6.1 Objective

To determine the power consumption of the test vehicle while operating on a sample service route at a defined level of schedule performance. The tests will provide a measure of car schedule performance, power consumption (regeneration), and overall traction system efficiency.

2.5.6.2 Description

The cars were operated over a simulated route with stops at specified stations. Normal service performance will be used. Power consumed by the traction and auxifliaries will be measured for each stop and the round-trip. The following test combinations can be tested.

| Procedure Options | Prime Variable | Test Conditions |
|---|---|---|
| (1) | Car weight | AW2 |
| (2) | Regeneration | 100% and 0% |
| (3) | Regeneration (Load) | 100% and 50% |
| (4) | Line voltage | Min, 600, & max. volts |
| (5) | Train consists | 2-car train |

2.5.6.3 Procedure

Cars 3700 and 3701 under AW0 and AW3 conditions were subjected to power consumption tests contained in AiResearch document 73-9373 in conformance with Test Set Number ESC-PC-5011-TT of TSC General Vehicle Test Plan GSP-064.

2.5.6.4 Results

The cars completed the power consumption tests successfully. However, during these tests there were QSD's that were traced to underrated SCR's and a zener causing a malfunction to the No. 2 flywheel alternator stator on car 3700. These SCR's and zener had not been updated to the latest configuration due to their unavailability.

A copy of the log for test runs 35 through 48 are included in Appendix C. Details and data reduced from tapes recorded during these tests are presented in Volume II. The data obtained also includes power for the motor-generator set air compressor.

2.5.7 RADIO FREQUENCY INTERFERENCE - ESC-PSI-6001-TT

2.5.7.1 Objective

To determine levels of broadband radiated electromagnetic emission from the test vehicle to the wayside.

2.5.7.2 Description

This test to be performed with test vehicle passing by a wayside station under each of the following conditions:

(a) Acceleration above and below base speed

(b) Constant speed

(c) Braking

2.5.7.3 Procedure

Cars 3700 and 3701 under AW0 conditions were subjected to the radio frequency interference test contained in AiResearch document 74-10441 in conformance with Test Set Number ESC-PSI-6001-TT of TSC General Vehicle Test Plan GSP-064. The following operations were performed during EMI evaluation:

(a) Power consumption

(b) Duty cycles

(c) Reliability

(d) Acceleration/Deceleration

(e) Constant speed

2.5.7.4 Results

The cars successfully completed the radio frequency interference tests. A copy of the log for test runs 80 through 82 are included in Appendix C. Details and data reduced from tapes recorded during these tests are presented in Volume II.

2.5.8 WAYSIDE EQUIPMENT NOISE SURVEY - ESC-CN-0001-TT

2.5.8.1 Objective

To determine the contribution of equipment noise to total test vehicle signature.

2.5.8.2 Description

This test was performed at a boarding platform area.

2.5.8.3 Procedure

Cars 3700 and 3701 under AW3 conditions were subjected to the external noise level tests contained in AiResearch documents 73-9373, and 74-10441 in conformance with Test Set Number ESC-CN-0001-TT of TSC General Vehicle Test Plan GSP-064.

2.5.8.4 Results

The cars completed the wayside equipment noise survey tests successfully. During the performance these tests there were several malfunctions; the main malfunction was on car 3700, flywheel No. 2, which required replacement.

A copy of the log for test runs 51 through 54 are included in Appendix C. Details and data reduced from tapes recorded during these tests are presented in Volume III.

2.5.9 WAYSIDE EFFECT OF CAR SPEED - ESC-CN-1001-TT

2.5.9.1 Objective

To determine wayside noise levels during vehicle passbys during constant speed conditions.

2.5.9.2 Description

This test was performed at a wayside station 50 feet from the track for the following conditions:

(a) Car weights of AW0 and AW3

(b) Single car and multiple units

(c) Five selected speeds

2.5.9.3 Procedure

Cars 3700 and 3701 under AW3 conditions were subjected to the external noise level tests contained in AiResearch document 73-9373 in conformance with Test Set Number ESC-CN-1001-TT of TSC General Vehicle Plan GSP-064.

2.5.9.4 Result

The cars completed the wayside effect of car speed tests successfully. A copy of the log for test runs 51 through 54 are included in Appendix C. Details and data reduced from tapes recorded during these tests are presented in Volume III.

2.5.10 ON CAR EFFECT OF SPEED - ESC-PN-1001-TT

2.5.10.1 Objective

To determine noise levels inside the test vehicle while operating at various speeds.

2.5.10.2 Description

This test was performed at the following conditions:

(a) Car weights of AW0 and AW3

(b) Four car interior locations

(c) Five car speeds

2.5.10.3 Procedure

The tests were performed in accordance with procedures described in AiResearch document 73-9373 in conformance with Test Set Number ESC-PN-1001-TT of TSC General Vehicle Test Plan GSP-064.

2.5.10.4 Results

The cars successfully completed the effect of speed test a copy of the log for test run 72 is included in Appendix C. Details and data reduced from tapes recorded during these tests are presented in Volume III.

2.5.11 ON CAR EFFECT OF TRACK SECTION - ESC-PN-1101-TT

2.5.11.1 Objective

To determine the effect of the track construction on interior noise levels.

2.5.11.2 Description

This test was performed at one test vehicle weight (AW0) and one speed on all sections of the UMTA test track.

2.5.11.3 Procedure

The tests were performed in accordance with procedures described in AiResearch document 74-10441 in conformance with Test Set Number ESC-PN-1101-TT of TSC General Vehicle Test Plan GSP-064.

2.5.11.4 Results

The cars successfully completed the effect of track section test. A copy of the log for test run 72 is included in Appendix C. Details and data reduced from tapes recorded during these tests are presented in Volume III.

2.5.12 INTERIOR NOISE SURVEY - ESC-PN-1301-TT

2.5.12.1 Objective

To determine the noise characteristics of the test vehicle by a survey of various passenger locations.

2.5.12.2 Description

This test was performed at a single test vehicle weight (AW0) while operating at a constant speed.

2.5.12.3 Procedure

Cars 3700 and 3701 under AW0 and AW3 conditions were subjected to interior noise level tests contained in AiResearch documents 73-9373 and in conformance with Test Set Number ESC-PN-1301 of TSC General Vehicle Test Plan GSP-064.

2.5.12.4 Results

The cars performed th interior noise survey tests successfully but experienced a malfunction during the noise level run. The OSD encountered during the test was due to a faulty diode in the auxiliary generator circuit of car 3701. This diode was of a lower rating than that specified by the latest design configuration.

The faulty diode was replaced with ahigher rated diode per latest drawing. Car 3701 now has a complete diode set per latest drawings.

A copy of the log for test runs 50, 71, and 72 are included in Appendix C. Details and data reduced from tapes recorded during these tests are presented in Volume III.

2.5.13 ON CAR ACCELERATION EFFECT - ESC-PN-2001-TT

2.5.13.1 Objective

To determine noise levels inside the test vehicle while accelerating.

2.5.13.2 Description

This test was performed on selected interior test points at test vehicle weights of AW0 and AW3.

2.5.13.3 Procedure

The tests were performed in accordance with procedures described in AiResearch documents 73-9373 and 74-10441 in conformance with Test Set Number ESC-PN-2001-TT of TSC General Vehicle Test Plan GSP-064.

2.5.13.4 Results

The cars successfully completed the acceleration effect tests. A copy of the log for test runs 53, 67, and 72 are included in Appendix C. Details and data reduced from tapes recorded during these tests are presented in Volume III.

2.5.14 ON CAR DECELERATION EFFECT - ESC-PN-3001-TT

2.5.14.1 Objective

To determine noise levels inside the test vehicle while decelerating.

2.5.14.2 Description

This test was performed on selected interior test points for various braking configuration at test vehicle weights of AW0 and AW3.

2.5.14.3 Procedure

The tests were performed in accordance with procedures described in AiResearch documents 73-9373 and 74-10441 in conformance with Test Set Number ESC-PN-3001-TT of TSC General Vehicle Test Plan GSP-064.

2.5.14.4 Results

The cars successfully completed the deceleration effect tests. A copy of the log for test runs 53, 67, and 72 are included in Appendix C. Details and data reduced from tapes recorded during these tests are presented in Volume III.

2.5.15 VERTICAL DYNAMIC SHAKE TEST - ESC-R-0001-XX

2.5.15.1 Objective

To determine the vehicle vertical natural modes and frequencies.

2.5.15.2 Description

This test will include performing frequency sweeps of the vehicle by using a shaker to provide excitation forces. These sweeps will be generated for selected locations of the vehicle to determine the natural frequencies. At these natural frequencies detailed probes of the vehicle are necessary to determine the associated mode shapes. This test will be performed at car weights of AW0, AW2 and AW3.

2.5.15.3 Procedure

Cars 3700 and 3701, under AW0, AW2, and AW3 conditions, were subjected to the vertical shake test described in AiResearch document 74-10441 in conformance with Test Set Number ESC-R-0001-XX of TSC General Vehicle Test Plan GSP-064.

2.5.15.4 Results

The cars successfully completed the vertical shake tests. A copy of the log for test runs 83 through 86 are included in Appendix C. Details and data reduced from tapes recorded during these tests are presented in Volume IV.

2.5.16 LATERIAL DYNAMIC SHAKE TEST - ESC-R-0002-XX

The lateral shake test was not performed due to the lack of a mounting fixture. (See log for test run 83 in Appendix C.)

2.5.17 LONGITUDINAL DYNAMIC SHAKE TEST - ESC-R-0003-XX

The longitudinal shake test was not performed due to the inability of the shaker to produce a measurable effect on the car body. (See log for test runs 83 through 86 in Appendix C.)

2.5.17.1 Objective

To determine the vibration levels of the test vehicle components while sationary on the UMTA test track.

2.5.17.2 Description

This test was performed on a stationary car at a known level section of track.

2.5.17.3 Procedure

Cars 3700 and 3701 under AW0 conditions were subjected to the component induced vibration tests described in AiResearch documents 73-9373 and 74-10441 in conformance with Test Set Number ESC-R-0010-TT of TSC General Vehicle Test Plan GSP-064.

2.5.17.4 Results

The cars successfully completed the component induced vibration tests. A copy of the log for test run 72 is included in Appendix C. Details and data reduced from tapes recorded during these tests are presented in Volume IV.

2.5.18 WORST SPEEDS - ESC-R-1101-TT

2.5.18.1 Objective

To determine worst steady vibration levels of the test vehicle on the UMTA test track.

2.5.18.2 Description

The following configurations were tested:

(a) Vehicle weights of AW0, AW2, and AW3

(b) All track sections including grade crossings and switches as required to simulate revenue service

(c) Select discrete vehicle speeds simulating revenue service and include V (max)

(d) Select other speeds as required to identify known or suspected acute vibration levels associated with carbody characteristics

2.5.18.3 Procedure

The tests were performed in accordance with procedures described in AiResearch document 74-10441 in conformance with Test Set Number ESC-R-1101-TT of TSC General Vehicle Test Plan GSP-064.

2.5.18.4 Results

The cars performed the worst speed tests successfully. A copy of the log for test runs 73 through 75 are included in Appendix C. Details and data reduced from tapes recorded during these tests are presented in Volume IV.

2.5.19 RIDE ROUGHNESS ACCELERATION - ESC-R-2001-TT

2.5.19.1 Objective

To determine the most servere vibration levels encountered during car acceleration.

2.5.19.2 Description

The test was performed on Track Section I at vehicle test weights of AW0, AW2, and AW3.

2.5.19.3 Procedure

The tests were performed in accordance with procedures described in AiResearch document 74-10441 in conformance with Test Set Number ESC-R-2001-TT of TSC General Vehicle Test Plan GSP-064.

2.5.19.4 Results

The cars successfully completed the ride roughness acceleration tests. A copy of the log for test runs 73, 78, and 79 are included in Appendix C. Details and data reduced from tapes recorded during these tests are presented in Volume IV.

2.5.20 RIDE ROUGHNESS DECELERATION - ESC-R-3001-TT

2.5.20.1 Objective

To determine the most severe vibration levels encountered during car deceleration.

2.5.20.2 Description

The test was performed on Track Section I at test vehicle weights of AW0, AW2, and AW3.

2.5.20.3 Procedure

The tests were performed in accordance with procedures described in AiResearch document 74-10441 in conformance with Test Set Number ESC-R-3001-TT of TSC General Vehcile Test Plan GSP-064.

2.5.20.4 Results

The cars successfully completed the ride roughness deceleration tests. A copy of the log for test runs 73, 78, and 79 are included in Appendix C. Details and data reduced from tapes recorded during these tests are presented in Volume IV.

# 3. TEST RESULTS

## 3.1 PERFORMANCE TESTS

The performance goal for acceleration and deceleration (blended braking) was to match the performance of the standard R-32 cars. Baseline data taken prior to modification indicated a full service braking rate of 3.45 mph/sec and an acceleration of 2.7 mph/sec at AWO weight. The energy storage car demonstrated performance of 3.7 mph/sec and 3.0 mph/sec respectively for these single point conditions. General car performance characteristics for acceleration and deceleration rates are shown in Figures 3-1 and 3-2. The acceleration data shown is indicative of system operation without weight compensation of tractive effort.

Deceleration rate for the AWO weight typically shows a high deceleration rate at the start of braking. This was caused by the jerk limit setting which permitted the friction brakes to apply before energization of the lock-out magnet, which cuts out the friction brake system. In subsequent dynamic brake tests, this setting was corrected by reducing the jerk limit to closely coincide with the response time of the friction brake application.

All of the dynamic brake tests show a sharp rise in deceleration as the car speed approaches zero. This is again caused by the lockout magnet deenergizing, thus cutting out dynamic braking and applying friction braking at approximately 4 mph. The energy storage cars were purposely configured in this manner to permit trainlining with the standard R-32 cars.

Refer to Volume II for details concerning the performance tests.

## 3.2 POWER CONSUMPTION TESTS

The primary goal of the energy storage car is to reduce the power consumption required for the conventional car. The overall results of the tests show that the advantages listed in Section 1 are attainable in practice, while still retaining the basic performance characteristics of the R-32 vehicle.

A typical 3000 foot run shown in Section 7 of Volume II, provides a means of comparison for the ESC and the unmodified R-32 (no unmodified R-32 test data was taken at Pueblo).

Figure 3-3 shows selected parameters from test run 78 record 1317. A plot of the traction motor armature current, multiplied by 2 is superimposed on the 3rd rail input current. Although not an exact comparison it is closely representative of R-32 car versus ESC 3rd rail input current and

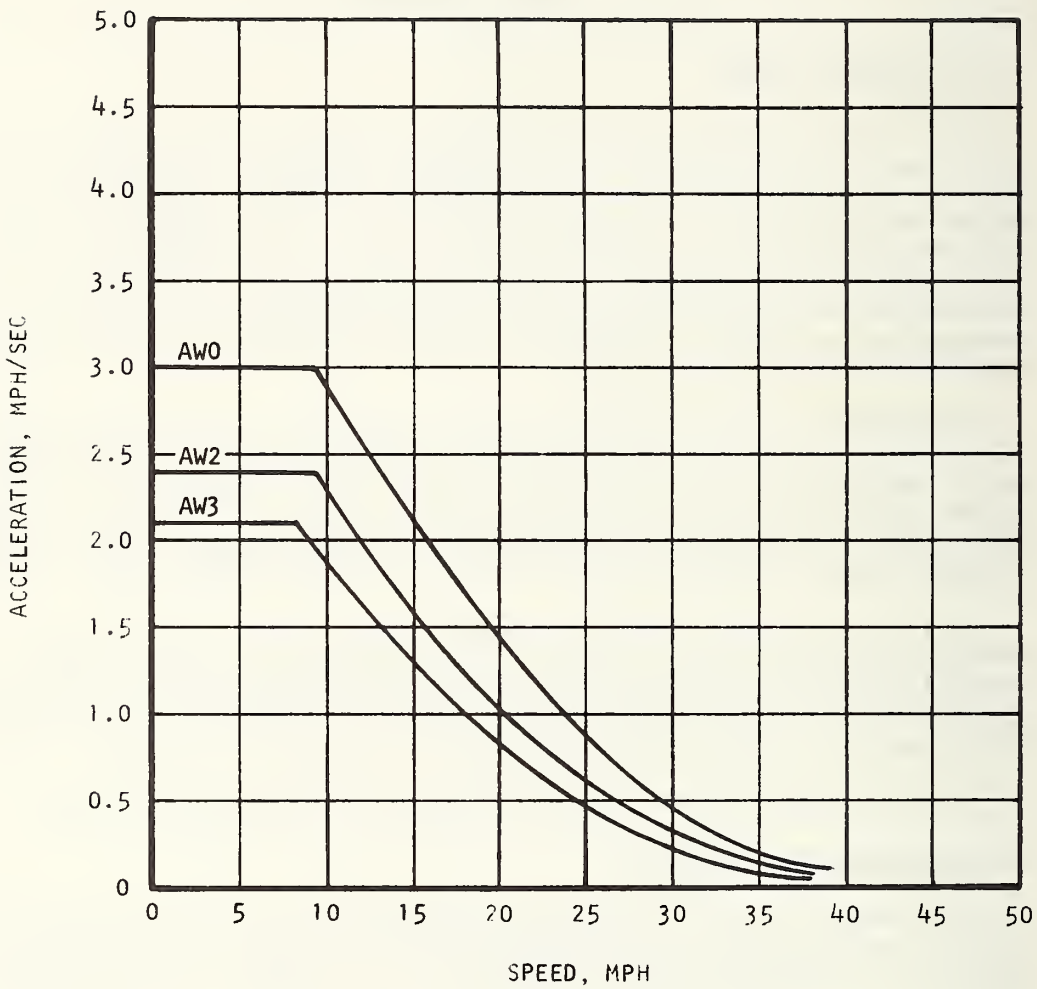



Figure 3-1. Parallel Mode-Acceleration vs Speed

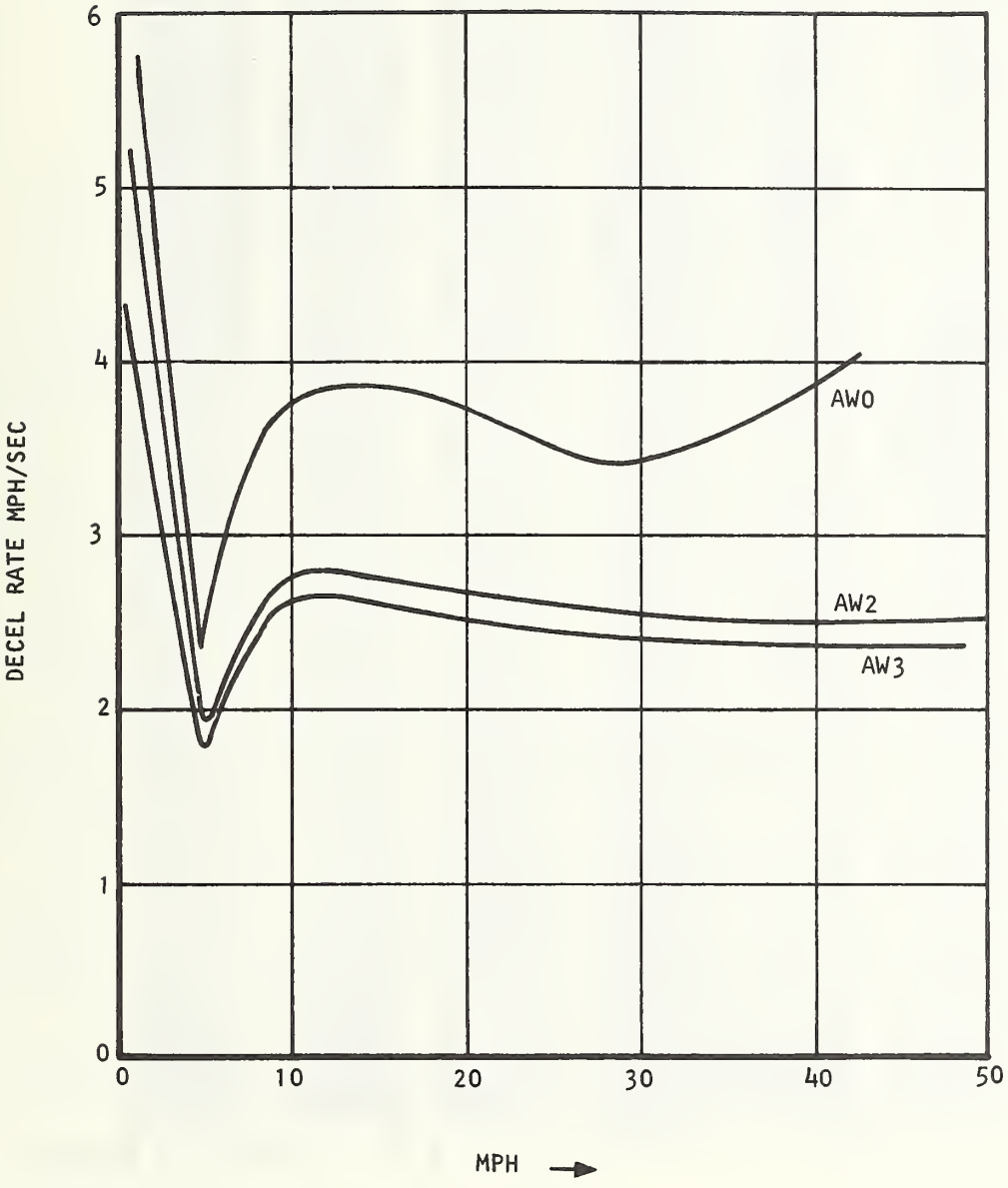



Figure 3-2. Full Service Brake-Deceleration Rate vs Speed

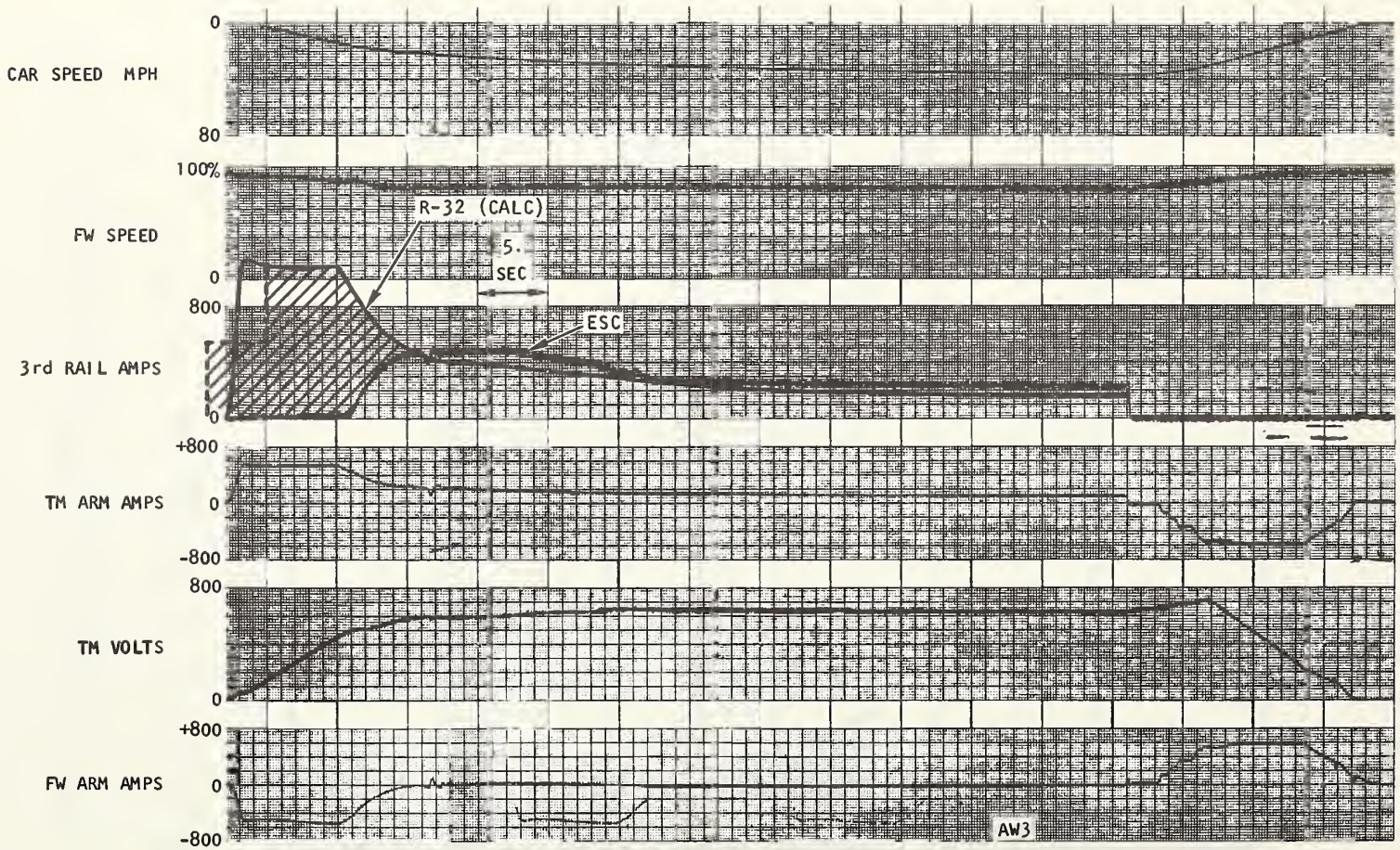



Figure 3-3. AW0 Run 78/1317-3000 Foot Level Tangent Track

graphically shows the advantages referred to previously. Quantitatively the comparison is as follows for this 3000 foot run:

| | ESC | R-32 (Calculated) |
|---|---|---|
| Peak line current | 490 amps | 1120 amps |
| RMS line current | 257 amps | 421 amps |
| Kw hrs/cm (approx) | 4.7 | 6.9 |

The implied energy saving is slightly in excess of 31 percent. The above values are for AW3 weight and do not include any station stop time.

A summary of the power consumption tests is shown in Figure 3-4. The curves shown here are faired-in averages of the clockwise and anticlockwise laps made for constant station stop distances. Actual test data for the AW0, 2000 foot station stop runs was appreciably better than the faired curve; it averaged 3.7 kw hrs/cm as shown in the detailed results of Volume II.

The relationship between flywheel speed and vehicle speed is shown in Figure 3-5 for a representative 3000 foot station-to-station run. This figure is a machine plot of the data shown in Figure 3-3.

Refer to Volume II for details concerning the power consumption tests.

## 3.3 RADIO FREQUENCY INTERFERENCE TESTS

The interior and wayside electromagnetic interference was measured for the 0.15 to 400 MHz range and plots are shown in Volume II for the various conditions of propulsion equipment. The data shown in Figure 3-6 shows the maximum exterior emissions levels relative to ambient.

The reference goals for SOAC (state-of-the-art car) are superimposed on Figure 3-6 as a matter of interest. It should be noted that SOAC did meet the requirement, however, the test location was at the far side of the track (in the southwest corner) where the background noise was at a much lower level. The ESC tests were carried out at a location near the north end of track Section I.

Refer to Volume II for details concerning the radio frequency interference tests.

## 3.4 EXTERIOR NOISE TESTS

The wayside noise measured at platform level and 50 feet away from the side of the car indicates that the noise range is greater than the standard under-car rotating equipment. Summary plots of these data are shown in Figures 3-7 and 3-8.

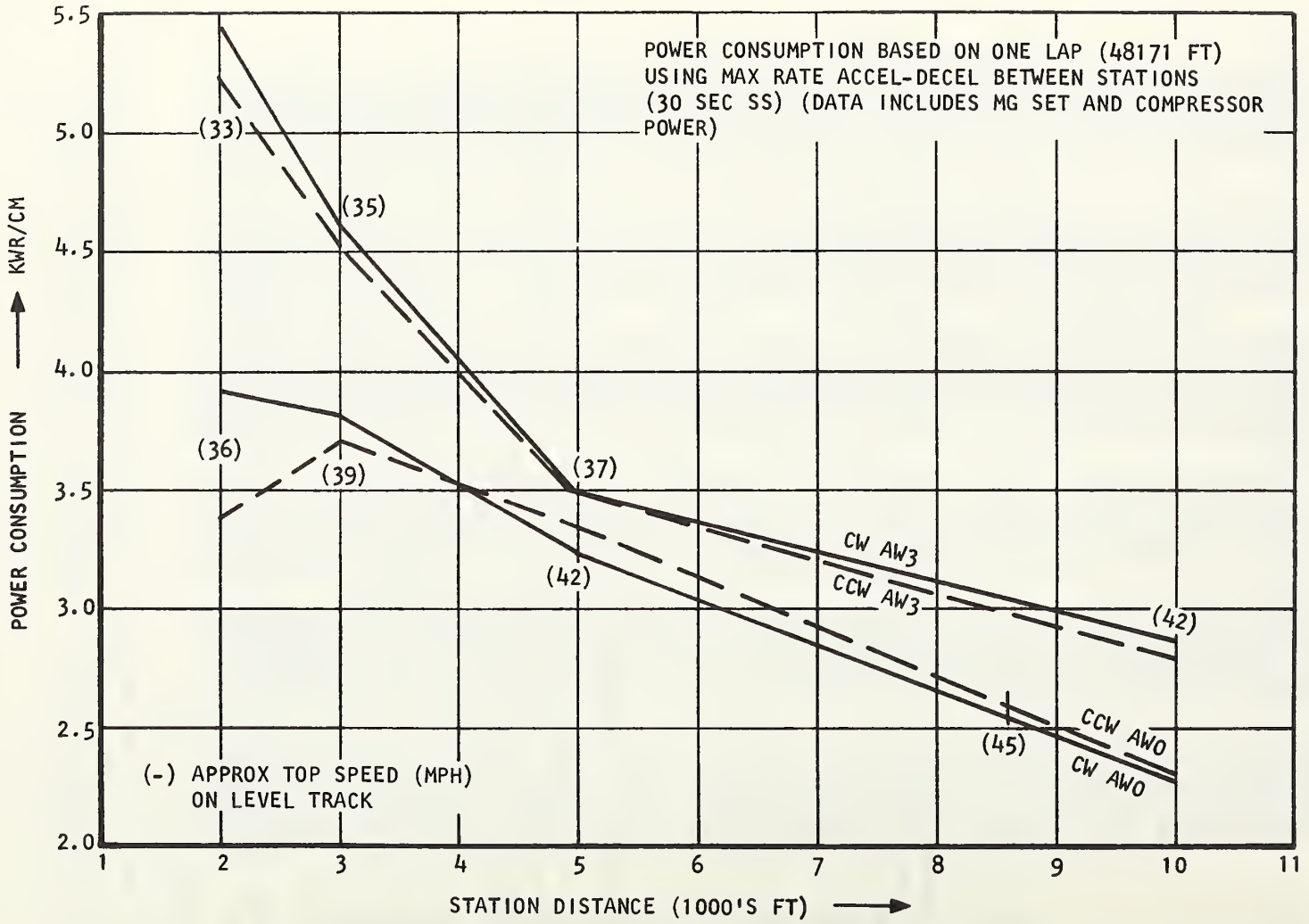



Figure 3-4. Power Consumption Test Summary

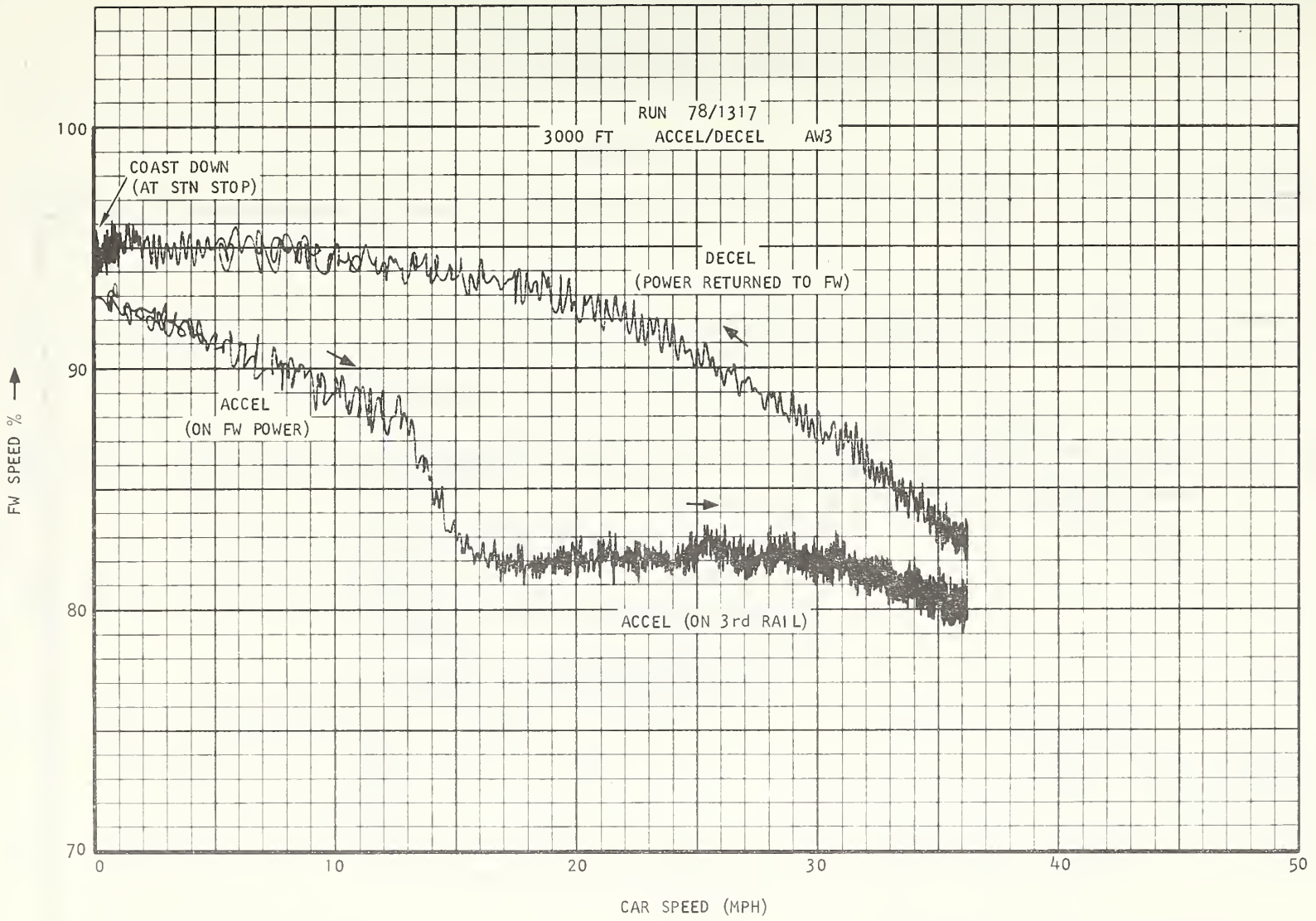



Figure 3-5. Flywheel Speed vs Car Speed

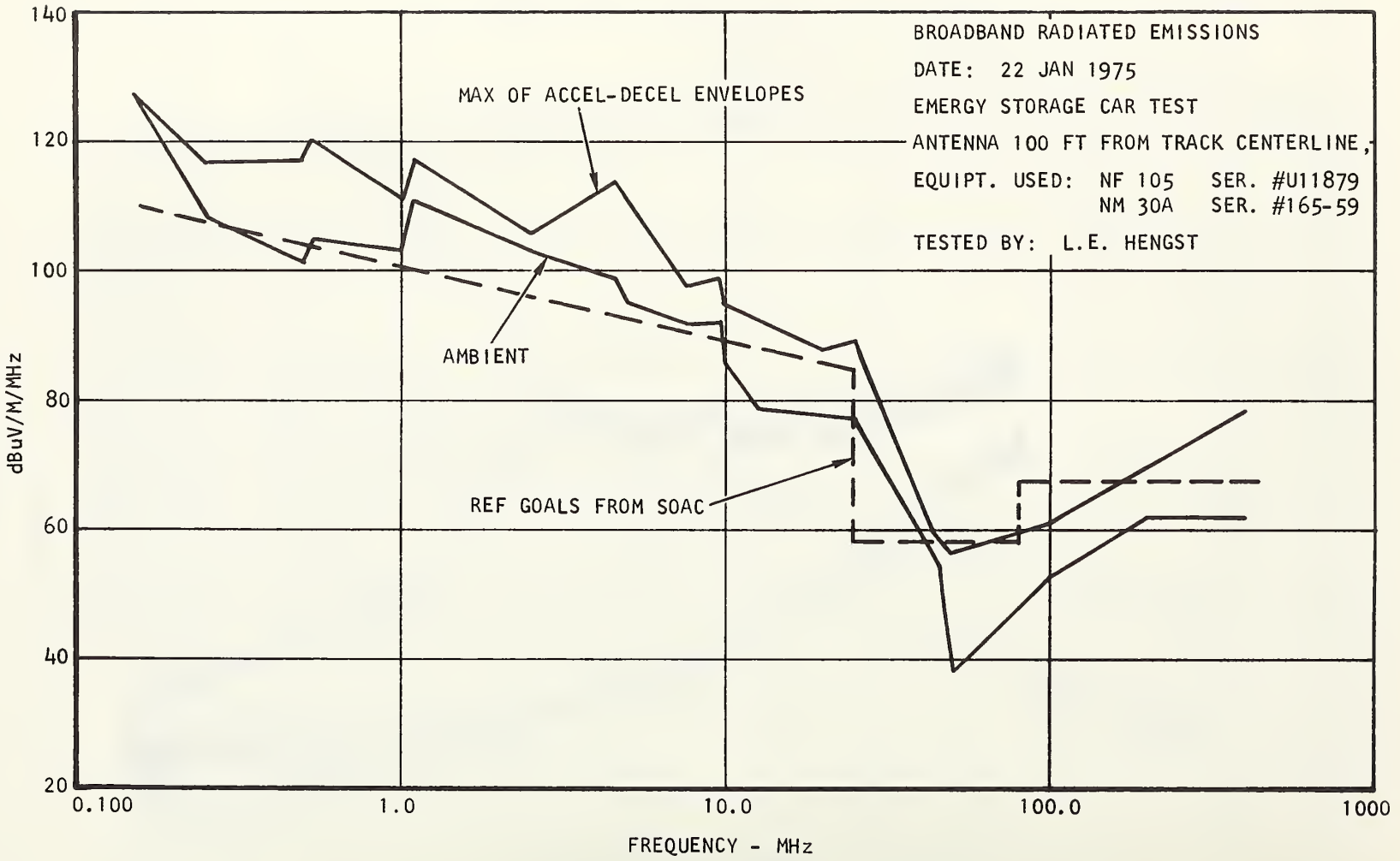



Figure 3-6. Broadband Radiated Emissions Tests-Exterior

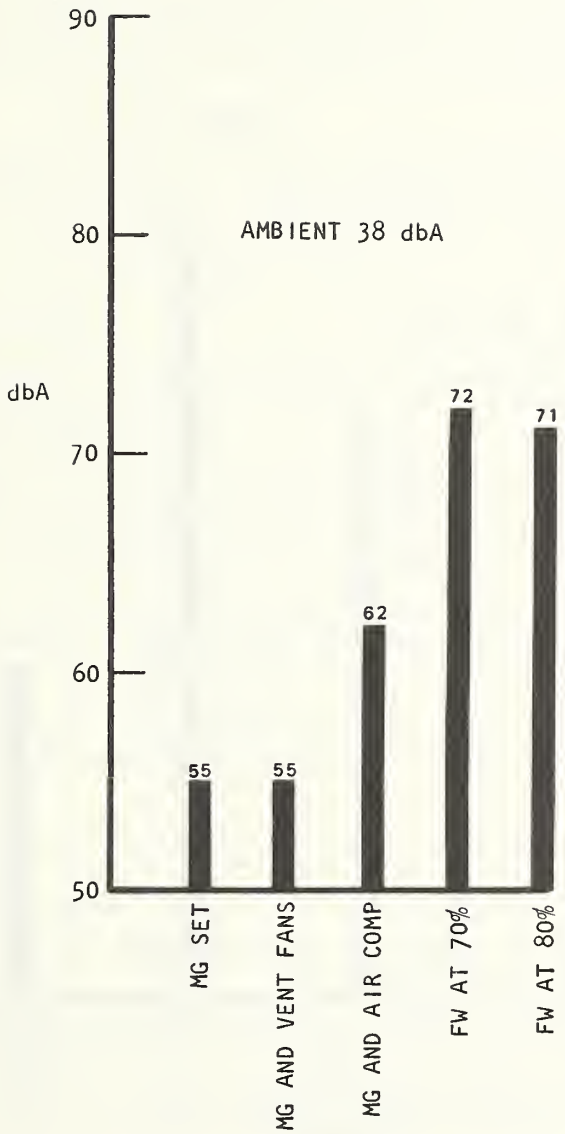



Figure 3-7. Exterior Noise Summary - Microphone 50 Feet From Track

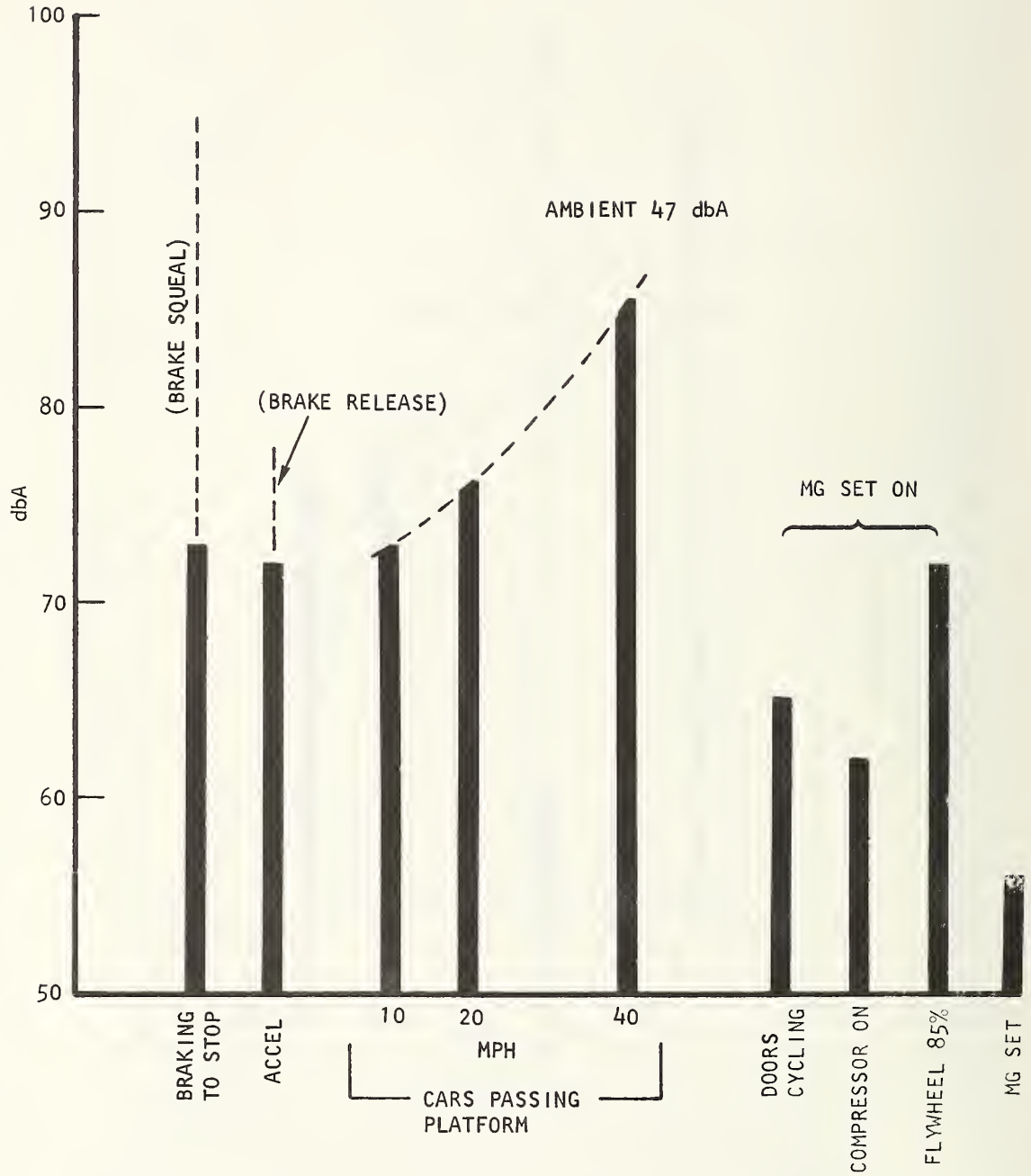



Figure 3-8. Exterior Noise Summary - Microphone on Platform

The under-car equipment noise, with car not moving, shows very little increase in level at the platform. Microphone perspective may account for this since only one platform location was used. Direct propagation from equipment on the far side and the ends of the train is partially blocked.

Moving vehicle data is shown at the center and left side of Figure 3-8. The momentary phenomena of brake squeal raching 95 dbA is the highest level. Generally the wheel rail noise at the platform is below 75 dbA except for fast moving cars.

At the time that these tests were conducted, the car wheels contained number of flats which would have some effect on the db levels recorded. A chart with the number and length of flats per wheel is shown in Figure 3-9.

Refer to Volume III for details concerning the exterior noise tests.

## 3.5 INTERIOR NOISE TESTS

Equipment interior noise contribution is summarized in Figure 3-10. The flywheel is the largest input with a slightly higher level at the low speed end of its operating range.

Noise levels in the moving train are shown in Figure 3-11 for different locations in the car at 40 mph. Higher levels toward the number two end are probably due to the adjacent car.

Runs were made over the six different track sections at constant speed. The noise level summary for these runs is shown in Figure 3-12 along with the configuration of each rail section.

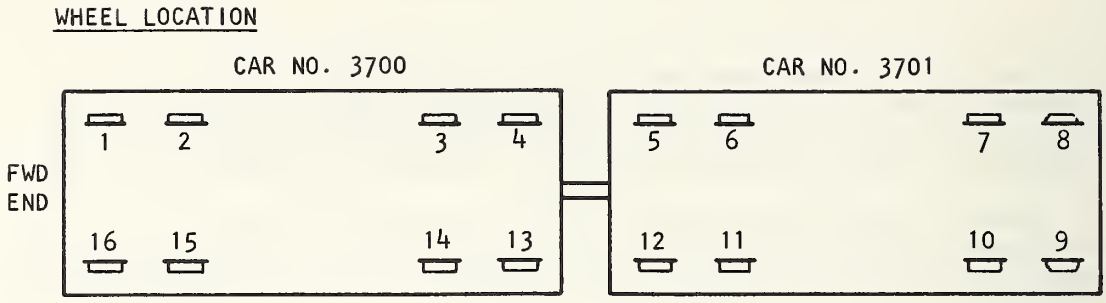
The higher ambient noise levels for the interior tests is probably due to the proximity of the gas driven generator used to power the instrumentation equipment.

Refer to Volume III for details concerning the interior noise tests.

## 3.6 RIDE ROUGHNESS TESTS

The induced dynamic shake and vibration levels for ride roughness evaluation is presented for a wide range of conditions. The modification with the energy storage propulsion system was not expected to cause any significant changes from the standard R-32 car in these parameters and the test results did not uncover any unusual characteristics. The shake tests revealed that the first three car body bending modes (at AW0 car weight) had natural frequencies of 7, 10.5 and 14.5 Hz. The results of the shake tests are shown in Figures 3-13 through 3-15.

Since there was no dominant worst speed condition the ride quality tests were run at a speed that could be controlled and maintained. Readings were taken at a carspeed of 35 mph, at two locations in the car for each track section as shown in the summary plots of Figures 3-16.




| Wheel No. | Number of Flats/Wheel | | |
|---|---|---|---|
| | 1-in.-Long | 1.5-in.-Long | 2-in.-Long |
| 1 | 3 | - | - |
| 2 | 5 | 2 | - |
| 3 | 2 | 1 | - |
| 4 | 4 | 2 | 1 |
| 5 | 3 | - | - |
| 6 | 3 | 3 | - |
| 7 | 1 | - | - |
| 8 | 3 | 2 | - |
| 9 | 2 | - | - |
| 10 | 1 | - | - |
| 11 | 2 | 1 | - |
| 12 | - | 1 | - |
| 13 | 1 | 4 | - |
| 14 | 1 | 2 | - |
| 15 | 6 | 1 | - |
| 16 | 1 | - | - |

Figure 3-9. Wheel Flats Measurement

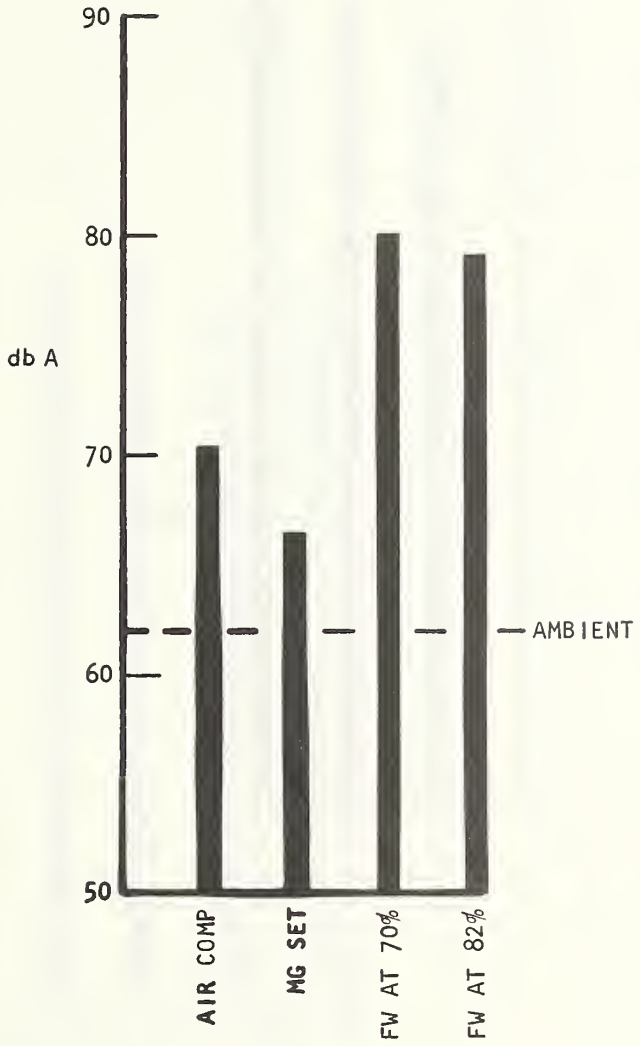



Figure 3-10. Interior Noise Summary - Equipment Noise Survey

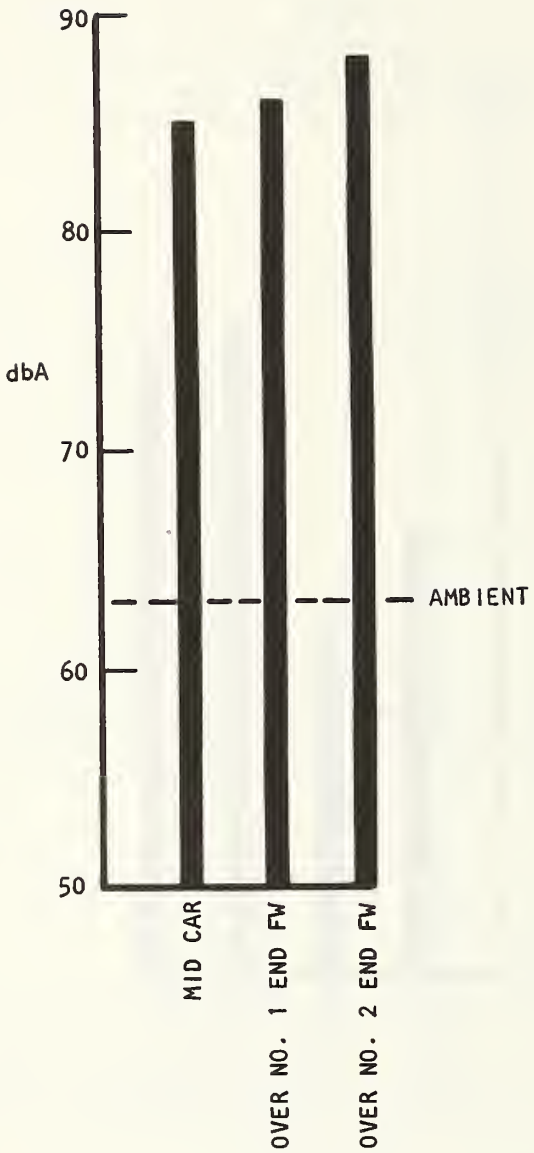



Figure 3-11. Interior Noise Summary - Constant Speed

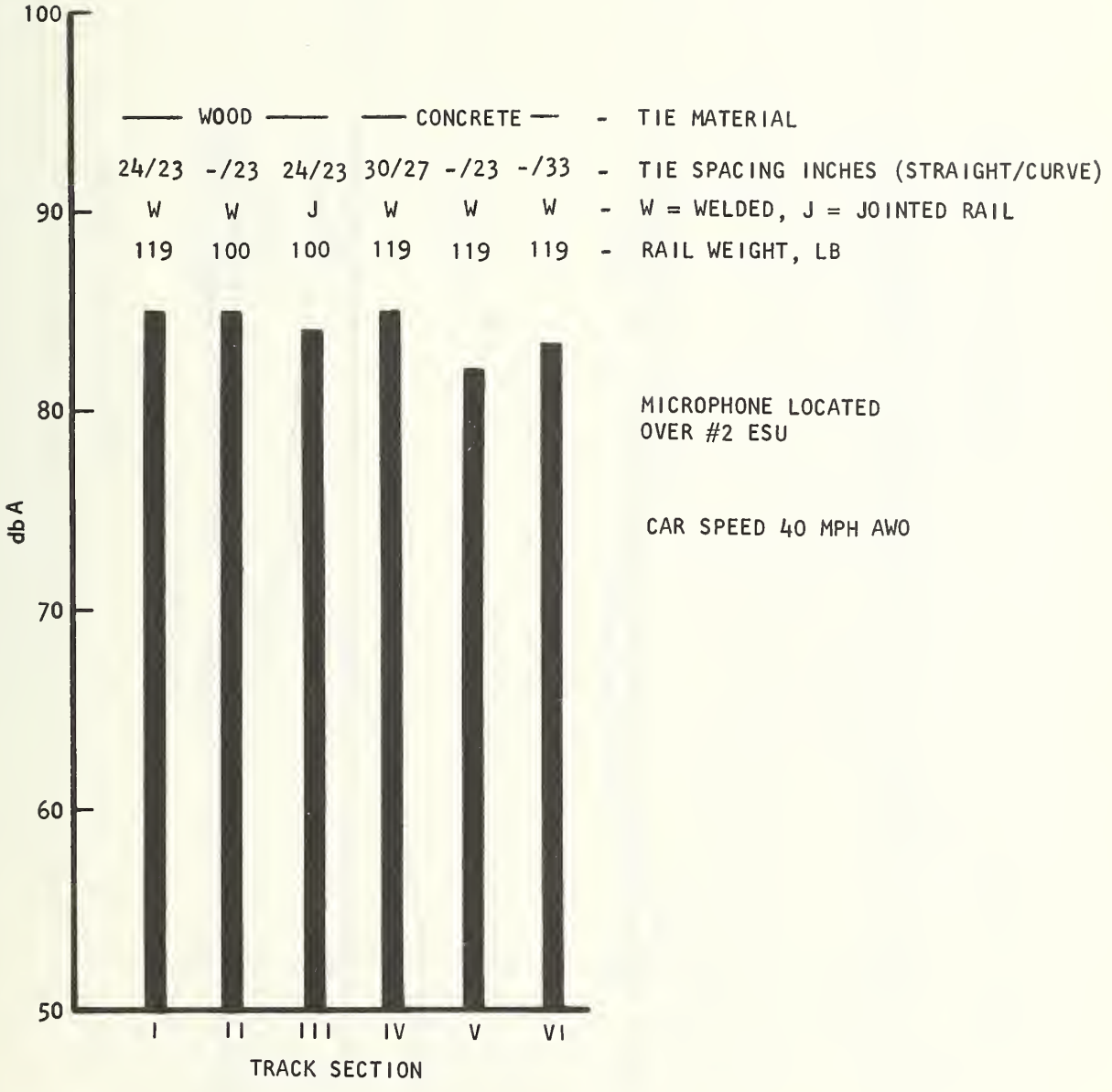



Figure 3-12. Interior Noise Summary-Track Configuration

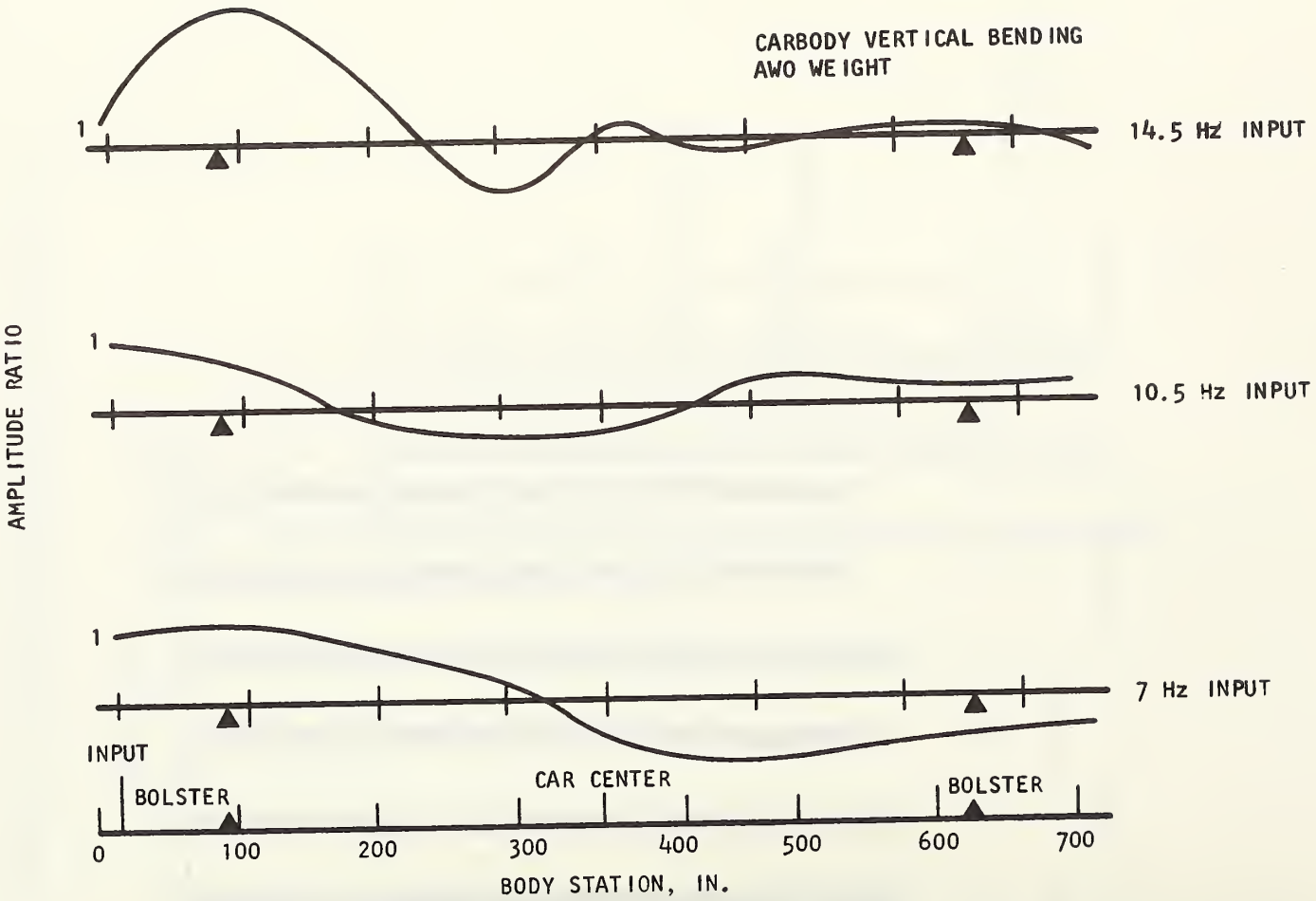



Figure 3-13. AWO Dynamic Shake Test - Vertical Mode

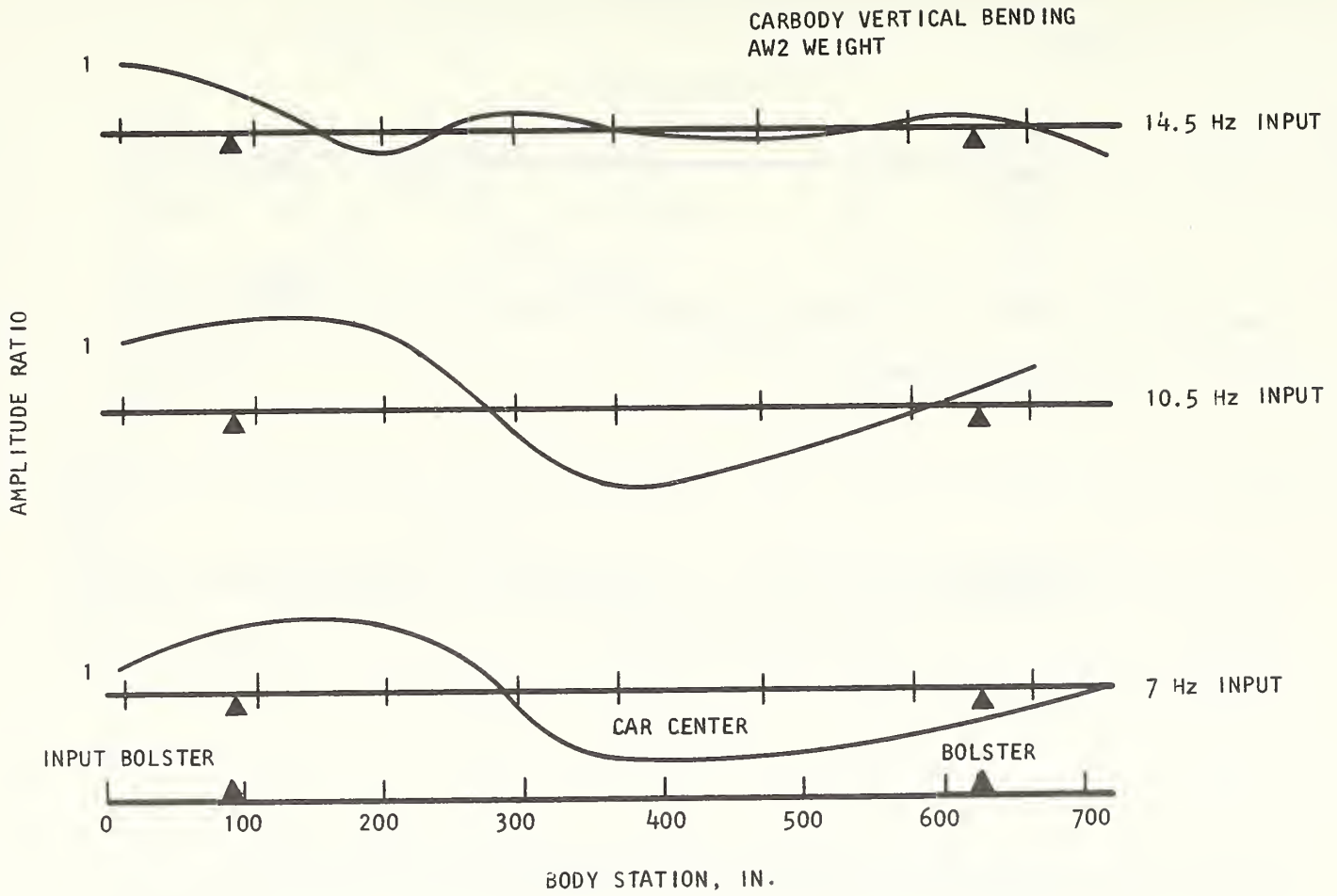



Figure 3-14. AW2 Dynamic Shake Test-Vertical Mode

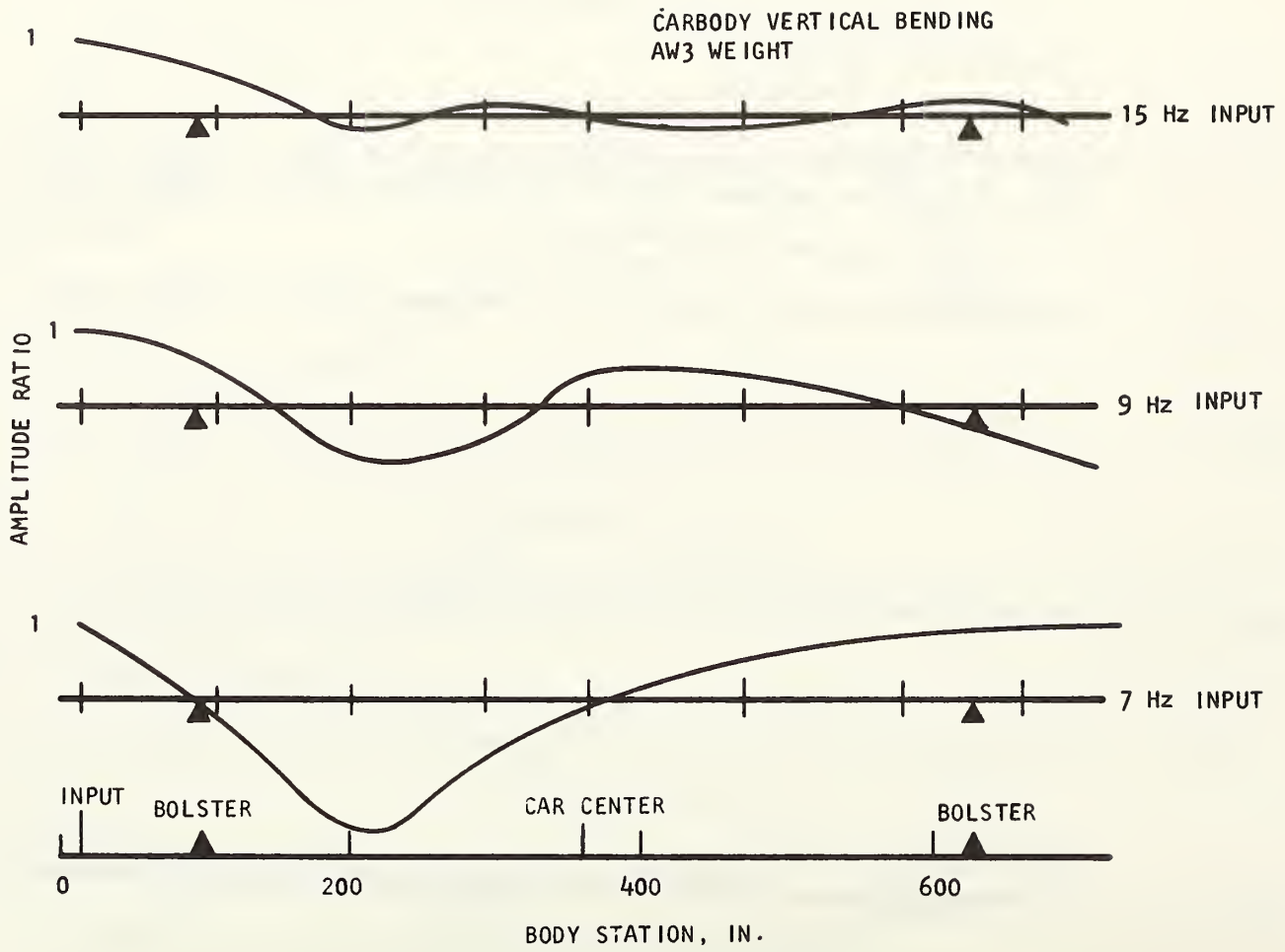
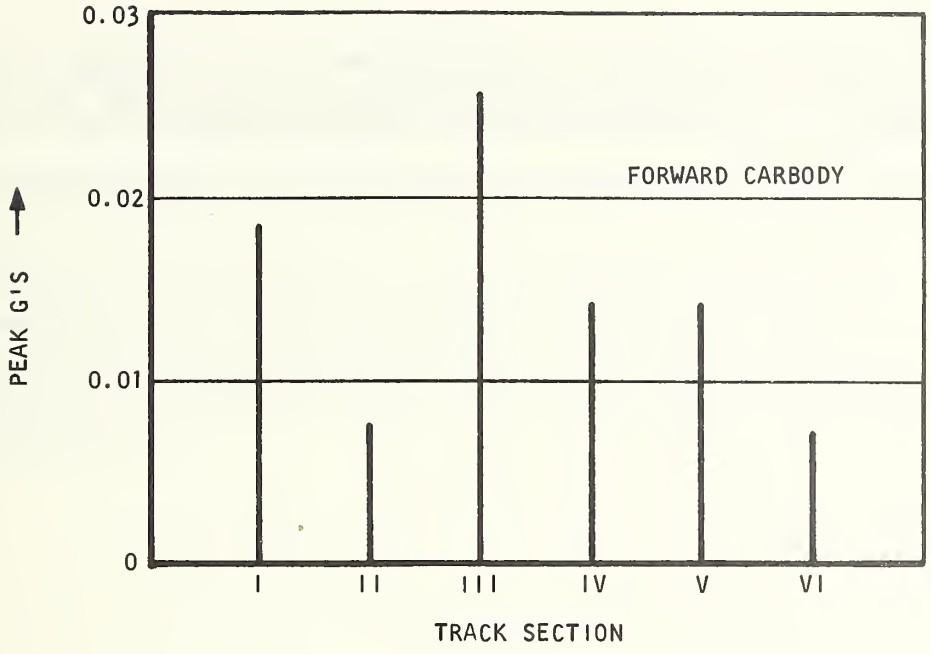



Figure 3-15. AW3 Dynamic Shake Test-Vertical Mode



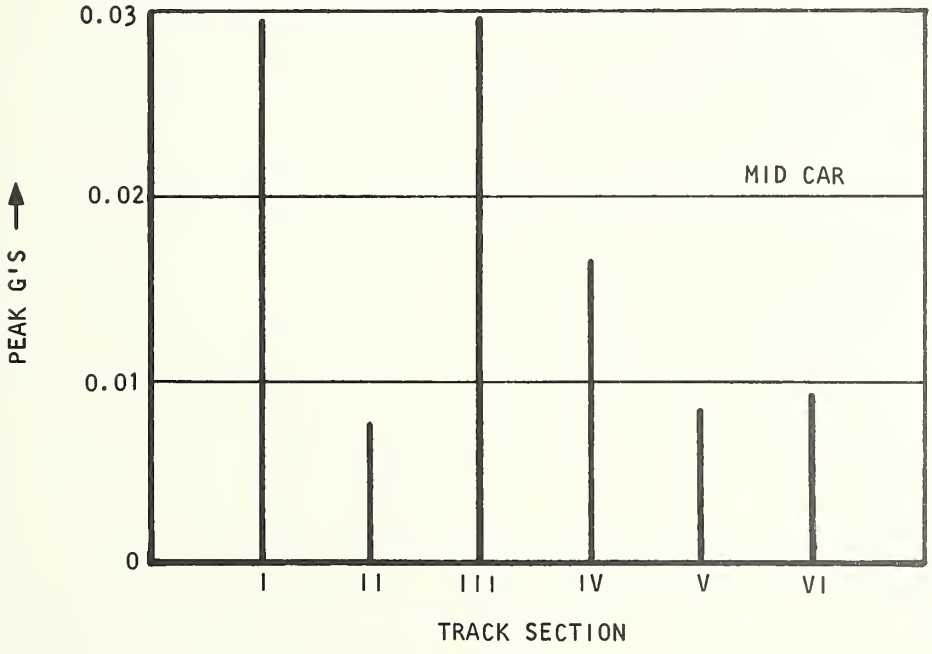




Figure 3-16. Ride Roughness Summary-Track Section Survey

Subjectively, track Section III seemed to provide the roughest ride and this was probably due to the ballast condition at the time of the test. High speed locomotive tests were being run on the track at night during this period.

Refer to Volume IV for details concerning the ride roughness tests.

# APPENDIX A

## REPORT OF INVENTIONS APPENDIX

The engineering tests conducted on the Energy Storage Cars utilized state-of-the-art testing technology and did not involve inventions or innovations. Development of the Energy Storage System being tested was carried out by Garrett AiResearch under a contract from the New York City Transit Authority. Inventions and innovations involved under that contract are not reported here.

# APPENDIX B

## TEST SET SUMMARY SHEETS

A GSP-064 Test Set summary sheet for each energy storage car test performed is provided here as a convenience for the reader. Each sheet covers the test objective, description, and status of a specific test.

TEST TITLE: ACCELERATION

TEST SET NUMBER: ESC-P-2001-TT

(Options 1 and 2)

TEST OBJECTIVE:

To determine the overall acceleration characteristics of the test vehicle as affected by controller input level, line voltage, car weight (load weighing, car direct, and train consist.

TEST DESCRIPTION:

The test vehicle will be accelerated at the required controller command on level tangent track. The following (example) combinations will be tested:

| Procedure Option | Prime Variable | Test Conditions |
|---|---|---|
| (4) | Controller level | Half and full power |
| (6) | Line voltage | Min: 600: and max. volts |
| (5) | Car weights | AW0; AW2; AW3 |
| (3) | Car direction | Forward and reverse |
| (7) | Train consists | Two car train |

STATUS:

The energy storage cars successfully completed the acceleration tests as prescribed by the conditions specified in paragraph 2.1.2. Refer to test log runs 49 and 55 presented in Volume I, Appendix C of this report.

TEST TITLE: DECELERATION-BLENDED BRAKING

TEST SET NUMBER: ESC-P-3001-TT

(Options 1 through 3)

TEST OBJECTIVE:

To determine the overall deceleration characteristics of the test vehicle utilizing the blended braking system as affected by controller input level, line voltage, car weight (load weighing), car direction, and train consist. Regeneration capability will be tested at varying line "load".

TEST DESCRIPTION:

The test vehicle will be decelerated at the required controller command on level tangent track. The following (example) test combinations will be tested:

| Procedure Option: | Prime Variable | Test Conditions |
|---|---|---|
| (5) | Controller Level | Half and full brake |
| (6) | Car weights | AW0; AW2; AW3 |
| (7) | Line voltage | Min; 600; and max. volts |
| (8) | Train consists | Two car train |
| (4) | Car direction | Forward and reverse |

STATUS:

The energy storage cars successfully completed the blended braking deceleration tests as prescribed by the conditions specified in paragraph 3.1.2. Refer to test log runs 55 and 76 presented in Volume I, Appendix C of this report.

TEST TITLE: DECELERATION - SERVICE FRICTION

TEST SET NUMBER: ESC-P-3002-TT

(Options 1 through 3)

TEST OBJECTIVE:

To determine the overall deceleration characteristics of the test vehicle utilizing the friction braking only system as affected by controller input level, car weight (load weighing), car direction, and train consist.

TEST DESCRIPTION:

The test vehicle will be decelerated at the required controller command on level tangent track. The following (example) test combinations will be tested:

| Procedure Option | Prime Variable | Test Conditions |
|---|---|---|
| (5) | Controller level | Half and full brake |
| (6) | Car weights | AW0; AW2; AW3 |
| (7) | Train consists | Two car train |
| (4) | Car direction | Forward and reverse |

STATUS:

The energy storage cars successfully completed the service friction deceleration tests as prescribed by the conditions specified in paragraph 4.1.2. Refer to test log runs 54, 55, 67 and 76 presented in Volume I, Appendix C of this report.

TEST TITLE: TRACTION RESISTANCE (DRIFT)

TEST SET NUMBER: ESC-P-4001-TT

(Option 1)

TEST OBJECTIVE:

To determine the traction (train) resistance of the test vehicle for use in the analysis of adhesion test data, to check the coefficients used to calculate the design performance of the vehicle, and as a baseline for analysis of the vehicle tractive and braking effort values.

TEST DESCRIPTION:

During the drift tests the test consists will be allowed to coast from an initial speed on level tangent track. Both propulsion and friction brake systems will be disabled to attain a true coast. The speed-time-distance data will be the source of the final resistance values.

| Procedure Option | Prime Variable | Test Conditions |
|---|---|---|
| (2) | Car weight | AW0 and AW2 |
| (3) | Train consist | Two car train |

STATUS:

The energy storage cars successfully completed the traction resistance tests as prescribed by the conditions specified in paragraph 5.1.2. Refer to test log runs 34, 71, 74 and 76 presented in Volume I, Appendix C of this report.

TEST TITLE: FRICTION BRAKE DUTY CYCLES

TEST SET NUMBER: ESP-P-5001-TT

TEST OBJECTIVE:

To determine the thermal capacity of the vehicle's friction braking system during a sample service run. The dynamic brake system will be inoperative during the tests with the friction brake providing all of the decelerating force, as applicable.

TEST DESCRIPTION:

The test vehicle will be accelerated to a target cruise speed, cruise for a defined time, and brake to a simulated station stop. Following a defined station dwell the cycle will be repeated.

| Procedure Option | Prime Variable | Test Conditions |
|---|---|---|
| (1) | Cruise speed and time | 35 mph for 45 sec.<br>50 mph for 55 sec. |
| (2) | Car weight | AW2 (or AW3) |
| (3) | Brake type | Solid and resilient wheels |
| (5) | Brake blending | Blended and frict. only |

STATUS:

The energy storage cars successfully completed the friction brake duty cycle tests as prescribed by the conditions specified in paragraph 6.1.2. Refer to test log runs 77 and 81 presented in Volume I, Appendix C of this report.

TEST TITLE: POWER CONSUMPTION

TEST SET NUMBER: ESC-PC-5011-TT

TEST OBJECTIVE:

To determine the power consumption of the test vehicle while operating on a sample service route at a defined level of schedule performance. The tests will provide a measure of car schedule performance, power consumption and overall traction system efficiency.

TEST DESCRIPTION:

The car(s) will be operated over a simulated route with stops at specified stations. Normal service performance will be used. Power consumed by the traction and auxiliaries will be measured for each stop and the round-trip

Examples of test conditions

| Procedure Options | Prime Variable | Test Conditions |
|---|---|---|
| (1) | Car weight | AW2 |
| (2) | Line voltage | Min; 600; max. volts |
| (3) | Train consists | Two car train |

STATUS:

The energy storage cars successfully completed the power consumption tests as prescribed by the conditions specified in paragraph 7.1.2. Refer to test log runs 35 through 48 presented in Volume I, Appendix C of this report.

TEST TITLE: RADIO FREQUENCY INTERFERENCE

TEST SET NUMBER: ESC-PSI-6001-TT

TEST OBJECTIVE:

To determine levels of broadband radiated electromagnetic emission from the test vehicle to the wayside.

TEST DESCRIPTION:

This test to be performed with test vehicle passing by a wayside station under each of the following conditions:

(a) Acceleration above and below base speed
(b) Constant speed
(c) Braking

STATUS:

The energy storage cars successfully completed the radio frequency interference tests as prescribed by the conditions specified in paragraph 8.1.2. Refer to test log runs 80 through 82 presented in Volume I, Appendix C of this report.

TEST TITLE: EQUIPMENT NOISE SURVEY - WAYSIDE

TEST SET NUMBER: ESC-CN-0001-TT

TEST OBJECTIVE:

To determine the contribution of equipment noise to total test vehicle signature.

TEST DESCRIPTION:

This test will be performed at a boarding platform area.

STATUS:

The energy storage cars successfully completed the equipment noise tests as prescribed by the conditions specified in paragraph 2.1.2. Refer to test log runs 51 through 54 presented in Volume I, Appendix C of this report.

TEST TITLE: EFFECT OF CAR SPEED - WAYSIDE

TEST SET NUMBER: ESC-CN-1001-TT

TEST OBJECTIVE:

Determine Wayside noise levels during vehicle passbys during constant speed conditions.

TEST DESCRIPTION:

This test will be performed at a wayside station 50 feet from the track for the following conditions:

(a) Vehicle weights of AW0 and AW3
(b) Single car and Multiple Units
(c) Five selected speeds

STATUS:

The energy storage cars successfully completed the exterior car speed tests as prescribed by the conditions specified in paragraph 3.1.2. Refer to test log runs 51 through 54 presented in Volume I, Appendix C of this report.

TEST TITLE: EFFECT OF CAR SPEED - ON CAR

TEST SET NUMBER: ESC-PN-1001-TT

TEST OBJECTIVE:

To determine noise levels inside the test vehicle while operating at various speeds.

TEST DESCRIPTION:

This test will be performed at the following conditions:

(a) Vehicle weights of AW0 and AW3
(b) Four car interior locations
(c) Five car speeds

STATUS:

The energy storage cars successfully completed the interior car speed tests as prescribed by the conditions specified in paragraph 4.1.2. Refer to test log run 72 presented in Volume I, Appendix C of this report.

TEST TITLE: EFFECT OF TRACK SECTION - ON CAR

TEST SET NUMBER: ESC-PN-1101-TT

TEST OBJECTIVE:

To determine the effect of track construction on interior noise levels.

TEST DESCRIPTION:

This test will be performed at one vehicle weight (AWO) and one speed on all sections of the UMTA test track.

STATUS:

The energy storage cars successfully completed the track section tests as prescribed by the conditions specified in paragraph 5.1.2. Refer to test log run 72 presented in Volume I, Appendix C of this report.

TEST TITLE: INTERIOR NOISE SURVEY

TEST SET NUMBER: ESC-PN-1301-TT

TEST OBJECTIVE:

To determine the noise characteristics of the test vehicle by a survey of various passenger locations.

TEST DESCRIPTION:

This test will be performed at one vehicle weight (AWO) while operating at a constant speed.

STATUS:

The energy storage cars successfully completed the interior noise tests as prescribed by the conditions specified in paragraph 6.1.2. Refer to test log runs 50, 71 and 72 presented in Volume I, Appendix C of this report.

TEST TITLE: ACCELERATION EFFECT - ON CAR

TEST SET NUMBER: ESC-PN-2001-TT

TEST OBJECTIVE:

To determine noise levels inside the test vehicle while accelerating.

TEST DESCRIPTION:

This test will be performed at selected interior test points for vehicle weights of AW0 and AW3.

STATUS:

The energy storage cars successfully completed the acceleration effect tests as prescribed by the conditions specified in paragraph 7.1.2. Refer to test log runs 53, 67 and 72 presented in Volume I, Appendix C of this report.

TEST TITLE: DECELERATION EFFECT - ON CAR

TEST SET NUMBER: ESC-PN-3001-TT

TEST OBJECTIVE:

To determine noise levels inside the test vehicle while decelerating.

TEST DESCRIPTION:

This test will be performed at the following conditions:

(a) For selected interior test points
(b) For various braking configurations (depends upon modes available on test vehicle). The basic configuration will be the normal service system.
(c) Vehicle weights of AW0 and AW3.

STATUS:

The energy storage cars successfully completed the deceleration effect tests as prescribed by the conditions specified in paragraph 8.1.2. Refer to test log runs 53, 67 and 72 presented in Volume I, Appendix C of this report.

TEST TITLE: DYNAMIC SHAKE TEST - VERTICAL

TEST SET NUMBER: ESC-R-0001-XX

TEST OBJECTIVE:

To determine the vehicle vertical natural modes and frequencies.

TEST DESCRIPTION:

This test will include performing frequency sweeps of the vehicle by using a shaker to provide excitation forces. These sweeps will be generated for selected locations of the vehicle to determine the natural frequencies. At these natural frequencies detailed probes of the vehicle are necessary to determine the associated mode shapes. The test will be performed at vehicle weights of AW0, AW2 and AW3.

STATUS:

The energy storage cars successfully completed the vertical shake tests as prescribed by the conditions specified in paragraph 2.1.2. Refer to test log runs 83 through 86 presented in Volume I, Appendix C of this report.

TEST TITLE: DYNAMIC SHAKE TEST - LATERAL

TEST SET NUMBER: ESC-R-0002-XX

TEST OBJECTIVE:

To determine the vehicle lateral natural modes and frequencies.

TEST DESCRIPTION:

This test will include performing frequency sweeps of the vehicle by using a shaker to provide excitation forces. These sweeps will be generated for selected locations of the vehicle to determine the natural frequencies. At these natural frequencies detail probes of the vehicle are necessary to determine the associated mode shapes. The test will be performed at vehicle weights of AW0, AW2 and AW3.

STATUS:

The lateral shake tests could not be performed due to the lack of a mounting fixture. Refer to test log run 83 (Volume I, Appendix C).

TEST TITLE: DYNAMIC SHAKE TEST - LONGITUDINAL

TEST SET NUMBER: ESC-R-0003-XX

TEST OBJECTIVE:

To determine the vehicle longitudinal natural modes and freuqencies.

TEST DESCRIPTION:

This test will include performing frequency sweeps of the vehicle by using a shaker to provide excitation forces. These sweeps will be generated for selected locations of the vehicle to determine the natural frequencies. At these natural frequencies detailed probes of the vehicle are necessary to determine the associated mode shapes. The test will be performed at vehicle weights of AW0, AW2 and AW3.

STATUS:

No test data or results could be obtained for the longitudinal shake tests because the output of the shaker was not able to produce a measurable effect on the car body. Refer to test log runs 83 through 86 (Volume I, Appendix C).

TEST TITLE: COMPONENT INDUCED VIBRATION

TEST SET NUMBER: ESC-R-0010-TT

TEST OBJECTIVE:

To determine the vibration levels of the test vehicle components while stationary on the UMTA Test Track.

TEST DESCRIPTION:

This test will be performed on a stationary car at a known level section of track.

STATUS:

The energy storage cars successfully completed the component induced vibration tests as prescribed by the conditions specified in paragraph 5.1.2. Refer to test log run 73 presented in Volume I, Appendix C of this report.

TEST TITLE: RIDE ROUGHNESS - WORST SPEEDS

TEST SET NUMBER: ESC-R-1101-TT

TEST OBJECTIVE:

To determine worst steady vibration levels of the test vehicle on the UMTA test track.

TEST DESCRIPTION:

The following configurations will be tested:

(a) Vehicle weights of AW0, AW2, AW3.
(b) All track sections including grade crossings and switches as required to simulate revenue service.
(c) Select discrete vehicle speeds simulating revenue service and include V (max).
(d) Select other speeds as required to identify known or suspected acute vibration levels associated with carbody characteristics.

STATUS:

The energy storage cars successfully completed the worst speeds tests as prescribed by the conditions specified in paragraph 6.1.2. Refer to test log runs 73 through 75 presented in Volume I, Appendix C of this report.

TEST TITLE: RIDE ROUGHNESS - ACCELERATION

TEST SET NUMBER: ESC-R-2001-TT

TEST OBJECTIVE:

To determine the most severe vibration levels encountered during car acceleration

TEST DESCRIPTION:

This test is to be performed on track section I at vehicle weights of AW0, AW2 and AW3

STATUS:

The energy storage cars successfully completed the acceleration tests as prescribed by the conditions specified in paragraph 7.1.2 Refer to test log runs 73, 78 and 79 presented in Volume I, Appendix C of this report.

TEST TITLE: RIDE ROUGHNESS - DECELERATION

TEST SET NUMBER: ESC-R-3001-TT

TEST OBJECTIVE:

To determine the most severe vibration levels encountered during car deceleration.

TEST DESCRIPTION:

This test to be performed on track section I at vehicle weights of AW0, AW2, AW3

STATUS:

The energy storage cars successfully completed the deceleration tests as prescribed by the conditions specified in paragraph 8.1.2. Refer to test log runs 73, 78 and 79 presented in Volume I, Appendix C of this report.

# APPENDIX C

## TEST RUN LOG SHEETS

Log sheets for the energy storage car test runs are presented in numerical order and provide a brief description of the tests, conditions and results of the performance evaluation tests.

ESC TEST RUN NO. 32 DATE 5-14-74

RUN TIME: START 2:00 WEATHER CONDITION: WIND VEL

STOP 5:00 DIRECTION

MILES RECORDED 20, 3700 Fwd and Rev AMBIENT AIR
20, R-42, Fwd and Rev TEMPERATURE

---

TEST PERSONNEL:

TEST CONTROLLER R. Begier

CHIEF TEST ENGINEER G. McClure

SAFETY ENGINEER G. Spons

VEHICLE OPERATOR Smith, Tate, Leaston, Beemler

INSTRUMENTATION Sessions

REAR MONITOR As req'd

GROUND CONTROLLER As req'd

ADDITIONAL PERSONNEL Lewis, DeDee

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TEST PROGRAM SPECIFICATION NO. 73-9373

TEST PROCEDURE NO. 4.3

TEST TITLE Performance verification - R-42 Trainline

VEHICLE CONFIGURATION 2 cars - empty wt.

---

TEST DESCRIPTION Functional checkout of ESC and R-42 cars in trainline. Record coupler displacement, accels, decel and drive from both end cabs.

---

COMMENTS Successfully demonstrated all trainline operations in TMB. Moved 4-car train to track - Successfully completed cond run in ccw dir driving from 3700. Ran through level tangent in Fwd (ccw) and Rev (cw) dir and recorded steady speed coupler displacement. Drawing ≈ 100 A more current above base speed on accel then drops to 200-300 steady state. No adverse personal reactions experienced bet R-32 and R-42 during accel. All running operations seemed

satisfactory bet both sets of cars. Braking effort seemed smooth.

Driving from 3700, ccw, Fwd:+.56 (3700 pulling)

" " " , cw, Rev: +.32 (3700 pushing)

Performed decel test at 48 mph, F.S. Brake

Performed accel test in Fwd dir (ccw)

Performed Accel Test in rev Dir (cw)

Changed drive cabs from ESC to R-42 and repeated.

F.S. Decel

ccw, Rev Accel

cw, Fwd Accel

Ran start-stop cycle every 3000' for 1 lap, driving from R-42 car.

Trainline compatibility looks good. No problems experienced during test.

Ran 4 car T/L from both cabs, both direction.

Successfully demonstrated running through rail gaps (45') w/o any difficulty.

4-car T/L test is considered complete.

Disconnected R-42 to set up for R-32 tests in a.m.

ESC TEST RUN NO. 33 DATE 5-15-74

RUN TIME: START 9:15 WEATHER CONDITION: WIND VEL 0

STOP 2:00 DIRECTION 0

MILES RECORDED 42 AMBIENT AIR TEMPERATURE

TEST PERSONNEL:

TEST CONTROLLER R. Begier

CHIEF TEST ENGINEER G. McClure

SAFETY ENGINEER G. Spon

VEHICLE OPERATOR Smith, Tate, Leaston, Beemler

INSTRUMENTATION Sessions

REAR MONITOR As Req'd

GROUND CONTROLLER As Req'd

ADDITIONAL PERSONNEL Lewis, Nickel, Smits

TEST PROGRAM SPECIFICATION NO. 73-9373

TEST PROCEDURE NO. 4.3

TEST TITLE Performance Verification - Accel, Decel

VEHICLE CONFIGURATION 2 cars - Empty Wt.

TEST DESCRIPTION Perform Accels and Decels per Test Plan. Give demo ride to Under Secretary of DOT, John V. Barnum. Reel 2.

COMMENTS Successfully completed accel and decel tests per test plan. Began to set instr'n up for drift test. Gave demo tour ride at 1:30 p.m.

ESC TEST RUN NO. 34 DATE 5-16-74

RUN TIME: START 9:30 WEATHER CONDITION: WIND VEL 0 MPH

STOP 4:30 DIRECTION

MILES RECORDED 40 AMBIENT AIR TEMPERATURE

TEST PERSONNEL:

TEST CONTROLLER R. Begier

CHIEF TEST ENGINEER G. McClure

SAFETY ENGINEER G. Spons

VEHICLE OPERATOR Smith, Tate, Leaston, Beemler

INSTRUMENTATION Sessions

REAR MONITOR As req'd

GROUND CONTROLLER As req'd

ADDITIONAL PERSONNEL Lewis, Nickel, Smits

TEST PROGRAM SPECIFICATION NO. 73-9373

TEST PROCEDURE NO. 4.3 ESC-P-4001-TT

TEST TITLE Performance verification - Drift, railgap and modes tests

VEHICLE CONFIGURATION 2 cars - empty wt.

TEST DESCRIPTION Perform drift test, railgap and dead rail test and mode change test per test plan. Reel 3.

COMMENTS Ran 2 sets of drift test due to longitudinal vib pickup cable defective - ran 1 set and then switched cables for 2nd set. Completed drift test. Ran Accel (max) Fwd and Rev driving from 3701. 2.53 mphps both dir. Successfully completed drift test, railgap and dead rail and mode change test per test plan. No problems experienced throughout day.

ESC TEST RUN NO. 35 DATE 5-17-74

RUN TIME: START 10:00 WEATHER CONDITION: WIND VEL

STOP 4:00 DIRECTION

MILES RECORDED 20 AMBIENT AIR TEMPERATURE

TEST PERSONNEL:

TEST CONTROLLER R. Begier

CHIEF TEST ENGINEER G. McClure

SAFETY ENGINEER G. Spons

VEHICLE OPERATOR Smith, Tate, Leaston, Beemler

INSTRUMENTATION Sessions

REAR MONITOR As req'd

GROUND CONTROLLER As req'd

ADDITIONAL PERSONNEL Lewis, Smits, LaFranchi, Carroll

TEST PROGRAM SPECIFICATION NO. 73-9373 GSP-064

TEST PROCEDURE NO. 4.3 ESC-PC-5011-TT

TEST TITLE Performance Verification - Power consumption test

VEHICLE CONFIGURATION 2 cars - empty wt.

TEST DESCRIPTION Run power consumption test per test plan - See Attachments.

COMMENTS On first brake initiation while driving from 3701, experienced T/L QSD on 3701 only. Experienced same in Rev dir. Switched driver's cab to 3700 - experienced same T/L QSD on 3700 but not 3701. Began investigating master controller for proper operation. Moved cars into barn to continue investigation on Saturday.

ESC TEST RUN NO. 36 DATE 5-20-74

RUN TIME: START 12:30 WEATHER CONDITION: WIND VEL

STOP 4:00 DIRECTION

MILES RECORDED 30 AMBIENT AIR TEMPERATURE

TEST PERSONNEL:

TEST CONTROLLER R. Begier

CHIEF TEST ENGINEER G. McClure

SAFETY ENGINEER G. Spons

VEHICLE OPERATOR Smith, Tate, Leaston, Beemler

INSTRUMENTATION Jenkins

REAR MONITOR As required

GROUND CONTROLLER As required

ADDITIONAL PERSONNEL Lewis

TEST PROGRAM SPECIFICATION NO. 73-9373 GSP-064

TEST PROCEDURE NO. 4.3 ESC-PC-5011-TT

TEST TITLE Performance Verification-Power Consumption Test

VEHICLE CONFIGURATION 2 Cars-Empty Wt.

TEST DESCRIPTION Perform Power consumption test per test plan; reel 4.

COMMENTS Initiated power consumption test per test plan. Completed Run Nos. 1 and 2. 3 to 1 OSD on current swapping. Shut down to investigate. Found F/W PDR volt trap had arced and under rated SCR's were damaged. Replaced SCR's with larger type as in T/m PDR's.

EST TEST RUN NO. 36 (Continued)

MONDAY A.M:

Found cause of Fridays QSD problem - under rated zener (1 watt) in LOM snubber network went out and caused short-to-gnd upon initial brake initiation.

Replace with temporary 1-watt zener. Will use 10 watt zeners when we receive them.

ESC TEST RUN NO. 37 DATE 5-21-74

RUN TIME: START 10:00 WEATHER CONDITION: WIND VEL

STOP 4:00 DIRECTION WSW

MILES RECORDED AMBIENT AIR TEMPERATURE

TEST PERSONNEL:

TEST CONTROLLER R. Begier

CHIEF TEST ENGINEER G. McClure

SAFETY ENGINEER G. Spons

VEHICLE OPERATOR Smith, Tate, Leaston, Beemler

INSTRUMENTATION Jenkins

REAR MONITOR As required

GROUND CONTROLLER As required

ADDITIONAL PERSONNEL Lewis, Nickel, Raskin

TEST PROGRAM SPECIFICATION NO. 73-9373 GSP-064

TEST PROCEDURE NO. 4.3 ESC-PC-5011-TT

TEST TITLE Perform verification-power cons test

VEHICLE CONFIGURATION 2 cars-empty wt.

TEST DESCRIPTION Continuation of power consumption test per test plan; reels 5 and 6.

COMMENTS Successfully completed cond run. Driving from 3701 in cw direction commenced Run No. 3. Must record power draw from lights, etc. to correct data for completed Runs 1, 2 and 3 in ccw direction. Experienced TMS on 3701 not opening during brake. Went to TMB to investigate, could not reproduce on simulated. Shorted out on 208 board. Resume testing in A.M.

ESC TEST RUN NO. 38 DATE 5-22-74

RUN TIME: START 10:00 WEATHER CONDITION: WIND VEL

STOP 5:00 DIRECTION

MILES RECORDED 25 AMBIENT AIR TEMPERATURE

TEST PERSONNEL:

TEST CONTROLLER R. Begier

CHIEF TEST ENGINEER G. McClure

SAFETY ENGINEER G. Spons

VEHICLE OPERATOR Smith, Tate, Leaston, Beemler

INSTRUMENTATION Jenkins

REAR MONITOR As required

GROUND CONTROLLER As required

ADDITIONAL PERSONNEL Lewis

TEST PROGRAM SPECIFICATION NO. 73-9373 GSP-064

TEST PROCEDURE NO. 4.3 ESC-PC-5011-TT

TEST TITLE Performance Verification-Power Consumption Test

VEHICLE CONFIGURATION 2 cars-empty wt.

TEST DESCRIPTION Continuation of Power Consumption Test per test plan; reels 6 and 7.

COMMENTS TMS operating properly on 3701 with CR13 jumper in. Noticed that during P.S. test, when driving from 3701 cw (fwd notch) and 3700 ccw (fwd notch) the following occurred:

| | cw 3701-fwd | ccw 3700-fwd |
|---|---|---|
| Run 2 | 80.7 Kwh/Lap | 69 |
| Run 3 | 85.1 Kwh/Lap | 56 |

ECS TEST RUN NO. 38 (Continued)

Switched to driving from 3700 - ccw fwd cw Rev

Run 2 - 60 Kwh/Lap

Run 3 - 65.4 Kwh/Lap

Will run P.C. test from 3700 in both directions.

4:30 P.M: Smoke coming from outside of car - investigation revealed No. 2 F/W on 3700 was source. F/W alternator stator showed signs of burned windings. Moved cars to TMB. Further investigation showed flashed over volt trap in F/W PDR. Stator must be replaced and 800 V PDR SCR's replaced with 1200V SCR's. This was the only PDR assembly that was not updated with the higher rated SCR's due to their unavailability.

ESC TEST RUN NO. 39 DATE 5-29-74

RUN TIME: START 9:05 WEATHER CONDITION: WIND VEL

STOP 5:15 DIRECTION

MILES RECORDED 91 AMBIENT AIR
1,1,1,1,1,1,1,1,1,1,1 TEMPERATURE

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TEST PERSONNEL:

TEST CONTROLLER R. Begier

CHIEF TEST ENGINEER G. McClure

SAFETY ENGINEER G. Spons

VEHICLE OPERATOR Smith, Tate, Leaston, Beemler

INSTRUMENTATION Jenkins

REAR MONITOR As required

GROUND CONTROLLER As required

ADDITIONAL PERSONNEL Lewis

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TEST PROGRAM SPECIFICATION NO. 73-9373 GSP-064

TEST PROCEDURE NO. 4.3 ESC-PC-5011-TT

TEST TITLE Performance Verification-Power Consumption Test

VEHICLE CONFIGURATION 2-cars-empty wt.

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TEST DESCRIPTION Perform Power Consumption Test per Test Plan; reels 8 and 9.

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COMMENTS Completed cond. Run. Re-ran Run No. 3 in ccw direction (Start = 9:40 stop = ). Chopper inductor running at 90°F - New inductor. Scrubbed run - Track was sprayed for weeds and substance on track made it too slippery - Wheels slide. Entered Run No. 4-ccw and completed same. Ran No. 4 in ccw dir. (Start = 12:35, Stop = ). Completed Run No. 4. Began Run No. 5. Completed Run 5.

ECS TEST RUN NO. 39 (Continued)

Completed Run No. 6

Run 7 - 58.8 (20) ccw

ccw

cw

cw

Upon second lap of Run 7, noticed instability in T/M currents - No. 2 truck drawing 800A, No. 1 truck drawing zero to - 300A. Shut down and went to TMB to investigate.

ESC TEST RUN NO. 40 DATE 6-17-74

RUN TIME: START 10:00 WEATHER CONDITION: WIND VEL

STOP 6:00 DIRECTION

MILES RECORDED 50 AMBIENT AIR TEMPERATURE
1,1,1,1,1

TEST PERSONNEL:

TEST CONTROLLER R. Begier

CHIEF TEST ENGINEER G. McClure

SAFETY ENGINEER G. Spons

VEHICLE OPERATOR Smith, Tate, Leaston, Beemler

INSTRUMENTATION Jenkins, Barnes

REAR MONITOR As required

GROUND CONTROLLER As required

ADDITIONAL PERSONNEL Lewis, Ebonbach

TEST PROGRAM SPECIFICATION NO. 73-9373 GSP-064

TEST PROCEDURE NO. 4.3 ESC-PC-5011-TT

TEST TITLE Performance Verification-Power Consumption Test

VEHICLE CONFIGURATION 2 cars-empty wt.

TEST DESCRIPTION Perform Power Consumption Test per Test Plan and perform Strain Gauge test per test plan; reel 9.

COMMENTS Successfully completed conditioning run. Commenced stress level evaluation tests. Completed Steps A, B, C, D, and E in level tangent. Repeated steps B, C, and D in minimum curved radius track section (STA 180-300, Rad = ($^{o}$30):

| Para | Sta Start | Sta Stop |
|---|---|---|
| B | 300 | 290 (Lost sig #5) |
| C | 300 | 265 |
| D | 300 | 280 |

ESC TEST RUN NO. 40 (Continued)

Completed step 'f' in following manner:

Entered Sta 300 at 35 mph and drove thru radius section at 45 mph from Sta 300-180 in ccw dir.

Spotcheck of 3000' P.C. Run at 45:

| Kwh/Lap | Kwh/Mile/car |
|---|---|
| 76.8 | 4.2 |

2000' P.C. Run @ 40:

Over 90 - run called due to wet track conditions.

ESC TEST RUN NO. 41 DATE 6-18-74

RUN TIME: START 09:00 WEATHER CONDITION: WIND VEL

STOP 12:00 DIRECTION

MILES RECORDED 0 AMBIENT AIR TEMPERATURE

TEST PERSONNEL:

TEST CONTROLLER D. Begier

CHIEF TEST ENGINEER G. McClure

SAFETY ENGINEER G. Spons

VEHICLE OPERATOR Smith, Tate, Leaston, Beemler

INSTRUMENTATION Barnes

REAR MONITOR As required

GROUND CONTROLLER As required

ADDITIONAL PERSONNEL Lewis, McCormick

TEST PROGRAM SPECIFICATION NO. 73-9373 GSP-064

TEST PROCEDURE NO. 4.3 ESC-PC-5011-TT

TEST TITLE Performance Verification-Power Consumption Test

VEHICLE CONFIGURATION 2 Cars-empty wt.

TEST DESCRIPTION Continue Power Consumption Test per Test Plan; reel 9.

COMMENTS Spent A.M. Calib. instructions.

ESC TEST RUN NO. 42 DATE 6-19-74

RUN TIME: START 9:00 WEATHER CONDITION: WIND VEL 0

STOP 6:00 DIRECTION

MILES RECORDED 128
1,1,1,1,1,1,1,1,1,1,1,1,1,1

AMBIENT AIR TEMPERATURE 85-100

TEST PERSONNEL:

TEST CONTROLLER W. I. Thomas

CHIEF TEST ENGINEER G. McClure

SAFETY ENGINEER G. Spons

VEHICLE OPERATOR Smith, Tate, Leaston, Beemler

INSTRUMENTATION Barnes

REAR MONITOR As required

GROUND CONTROLLER As required

ADDITIONAL PERSONNEL Lewis, McCarty

TEST PROGRAM SPECIFICATION NO. 73-9373 GSP-064

TEST PROCEDURE NO. 4.3 ESC-PC-5011-TT

TEST TITLE Performance Verification-Power Consumption Test

VEHICLE CONFIGURATION 2 Cars-empty wt.

TEST DESCRIPTION Test to be performed per Test Plan; reels 9 and 11.

COMMENTS Ran chopper ind. temp test - o to 80% in 10% increments. Completed cond. run. Commenced 2nd lap of Run #7, ccw dir. Successfully completed Run #7. Run #8 = Accel to 45 & Brake to 15, Accel to 30 & brake to 15, Accel to 45... Stop every 5000'. Successfully completed Run No. 8. Began Run 9. Successfully completed Run No. 9.

ESC TEST RUN NO. 42 (Continued)

Experienced TMS on 3701 not opening upon braking infrequently Will investigate tomorrow in Barn in A.M.

Began Run No. 10. 3701 QSD with Aux. gen lite - possible loss of SCR in PDR. Will Move to TMB to investigate. Scrub initial Run No. 10.

Need from Torr:

1 - Spare SCR's

2 - Spare volt traps

3 - PDR insulating stand - offs for 51 ohm resistors

4 - Qty = 4 - 51Ω resistors for PDR.

Investigation revealed that 3701 T/M and F/W PDR's were in good condition and not the source of problem. Simulator checkout showed problem to be in ECU. Intermittent occurrance in ECU on simulator - Looking at CARD #209. Prep cars for test continuation and 3701 ECU investigation.

ESC TEST RUN NO. 43 DATE 6-20-74

RUN TIME: START 3:20 WEATHER CONDITION: WIND VEL

STOP 5:30 DIRECTION

MILES RECORDED 20 AMBIENT AIR TEMPERATURE

TEST PERSONNEL:

TEST CONTROLLER R. Begier

CHIEF TEST ENGINEER G. McClure

SAFETY ENGINEER G. Spons

VEHICLE OPERATOR Smith, Tate, Leaston, Beemler

INSTRUMENTATION Barnes

REAR MONITOR

GROUND CONTROLLER

ADDITIONAL PERSONNEL Lewis, McCarty

TEST PROGRAM SPECIFICATION NO. 73-9373 GSP-064

TEST PROCEDURE NO. 4.3 ESC-PC-5011-T

TEST TITLE Performance Verification-Power Consumption Test

VEHICLE CONFIGURATION 2 cars-empty wt.

TEST DESCRIPTION Continue Power consumption test per Test Plan; reel 11.

COMMENTS Continued investigation of TMS problem on 3701 revealed that FSR1 diode was shorted and caused R-13 relay to function improperly. R-13 relay finally burned 2 contacts. Replaced relay and diode.

Suspected Problem: Bad diode (0115) caused by previous loss of PDR and diodes D113 & D114 shorted which resulted in malfunction in 307 board and R-13 relay.

ESC TEST RUN NO. 43 (Continued)

Replaced all 3 diodes and relay and 307 board (found spare 307 had been running in 3701 for some time, it was board that failed).

ESC TEST RUN NO. 44 DATE 6-21-74

RUN TIME: START 08:45 WEATHER CONDITION: WIND VEL

STOP 8:00 DIRECTION

MILES RECORDED 91
1,1,1,1,1,1,1,1,1,1 AMBIENT AIR TEMPERATURE 100+

TEST PERSONNEL:

TEST CONTROLLER R. Begier
CHIEF TEST ENGINEER G. McClure
SAFETY ENGINEER G. Spons
VEHICLE OPERATOR Smith, Tate, Leaston, Beemler
INSTRUMENTATION Barnes
REAR MONITOR
GROUND CONTROLLER
ADDITIONAL PERSONNEL Lewis, McCarty

TEST PROGRAM SPECIFICATION NO. 73-9373 GSP-064
TEST PROCEDURE NO. 4.3 ESC-PC-5011-TT
TEST TITLE Performance Verification
VEHICLE CONFIGURATION 2 cars-empty wt.

TEST DESCRIPTION Complete Power Consumption Test and Run Drift Test; reels 11 and 12.

COMMENTS Successfully completed Run No. 10 of energy consum. test - empty wt. Performed re-run of Run No. 6 to further validate 3000' point. Completed Run No. 6. Gave demo to London Transit and Lockheed. Began re-run of Run No. 5. Completed Run No. 5. Postponed Drift test until later.

ESC TEST RUN NO. 45 DATE 6-24-74

RUN TIME: START 09:45 3rd rail WEATHER CONDITION: WIND VEL 5-10

STOP 3:30 DIRECTION West

MILES RECORDED 20 AMBIENT AIR TEMPERATURE 70

TEST PERSONNEL:

TEST CONTROLLER R. Begier

CHIEF TEST ENGINEER H. Lewis

SAFETY ENGINEER G. Spons

VEHICLE OPERATOR Smith, Tate, Leaston, Beemler

INSTRUMENTATION Barnes

REAR MONITOR

GROUND CONTROLLER

ADDITIONAL PERSONNEL McCarty

TEST PROGRAM SPECIFICATION NO. 73-9373 GSP-064

TEST PROCEDURE NO. 4.3 ESC-PC-5011-TT

TEST TITLE Performance Verification

VEHICLE CONFIGURATION 2 cars - 42,000 lbs Ballast each

TEST DESCRIPTION Commence max wt. power consumption test; reel 13.

COMMENTS Completed Run No. 1 of max. wt. Power Cons. Test. Experienced 3700 aux gen relay not functioning - Car would not regulate at 100% F/W speed. Went to barn to investigate. Found fuse F10 was blown which caused loss of 32 vdc output which kept F/W sys on batteries.

ESC TEST RUN NO. 46 DATE 6-25-74

RUN TIME: START 12:45 WEATHER CONDITION: WIND VEL

STOP 7:45 DIRECTION

MILES RECORDED 72.8 AMBIENT AIR
1,1,1,1,1,1,1,1 TEMPERATURE

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TEST PERSONNEL:

TEST CONTROLLER R. Begier

CHIEF TEST ENGINEER G. McClure

SAFETY ENGINEER G. Spons

VEHICLE OPERATOR Smith, Tate, Leaston, Beemler

INSTRUMENTATION Barnes

REAR MONITOR

GROUND CONTROLLER

ADDITIONAL PERSONNEL Lewis, McCarty

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TEST PROGRAM SPECIFICATION NO. 73-9373 GSP-064

TEST PROCEDURE NO. 4.3 ESC-PC-5011-TT

TEST TITLE Performance Verification-Power Consumption Test

VEHICLE CONFIGURATION 2 cars-max. wt.

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TEST DESCRIPTION Perform test per test plan; reels 14 and 15

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COMMENTS Successfully completed Run No. 1, 2, 3, & 4 ccw. Experienced FW/TL and aux. gen QSD on 3700 when shifting to coast during cw 15 mph run. ABRS "ON" ALB "OFF" on reset: AFWS "ON", AFWES "ON", ALB "ON" up to 40% - then trip and FW/TL "ON", ABRS "ON", ALB "OFF".

Attempted re-set in A.M. - No problem experienced with re-set-F/W's came up.

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ESC TEST RUN NO. 47 DATE 6-26-74

RUN TIME: START 11:00 WEATHER CONDITION: WIND VEL

STOP 7:00 DIRECTION

MILES RECORDED 91 AMBIENT AIR TEMPERATURE

TEST PERSONNEL:

TEST CONTROLLER R. Begier

CHIEF TEST ENGINEER G. McClure

SAFETY ENGINEER G. Spons

VEHICLE OPERATOR Smith, Leaston, Beemler

INSTRUMENTATION Barnes

REAR MONITOR

GROUND CONTROLLER

ADDITIONAL PERSONNEL Lewis, McCarty

TEST PROGRAM SPECIFICATION NO. 73-9373 GSP-064 GSP-064

TEST PROCEDURE NO. 4.3 ESC-PC-5011-TT

TEST TITLE Performance Verification-Max wt. Power Consumption

VEHICLE CONFIGURATION 2 cars-max. wt.

TEST DESCRIPTION Perform tests per Test Plan; reels 16 and 17

COMMENTS Completed cw Run No. 4. During re-start, F10 fuse was blown on 3700- Replaced fuse and continued testing, completed Run No. 5 and 6. During Run 7, 3701 experienced QSD - found blown fuses F33, F34, and F35. Replaced fuses and continued testing. Experienced same QSD on 3700 and 3701 as experienced last nite. QSD becoming more frequent towards end of day.

ESC TEST RUN NO. 48 DATE 6-27-74

RUN TIME: START 9:40 WEATHER CONDITION: WIND VEL

STOP 9:00 DIRECTION

MILES RECORDED 100 AMBIENT AIR TEMPERATURE

TEST PERSONNEL:

TEST CONTROLLER R. Begier

CHIEF TEST ENGINEER G. McClure

SAFETY ENGINEER G. Spons

VEHICLE OPERATOR Smith, Leaston, Beemler

INSTRUMENTATION Barnes

REAR MONITOR

GROUND CONTROLLER

ADDITIONAL PERSONNEL Lewis, McCarty

TEST PROGRAM SPECIFICATION NO. 73-9373 GSP-064

TEST PROCEDURE NO. 4.3 ESC-PC-5011-TT

TEST TITLE Performance Verification-Power Consumption. Max. wt.

VEHICLE CONFIGURATION 2 cars-Max. Wt.

TEST DESCRIPTION Continue Power Consumption Test - Max. wt per Test Plan; reels 18 and 19.

COMMENTS Completed Run No's. 8 and 9 of Power Consumption Test. Plagued by trips on 3700 (Aux gen, F10 fuse) and 3701 (Aux. gen, F33, 34 & 35). Also, 3701 has Fw overspeed trip (DB5 does not close at overspeed). 3701 problem seems associated with F/W overspeed during end of brake - Pops fuses. Completed Run No. 10 which completes max. wt. P.C. Changed 103 board in 3701. Did not experience flashing L/B lite. Must investigate aux. gen on 3700 & aux. gen and DBS on 3701.

ESC TEST RUN NO. 48 (Continued)

Investigation revealed in barn that entire Bank of 12 fuses on 3701 which included F-33, 34 & 35 were undersized: Should be 20A instead of 10A. Replaced with 20A fuses. F10 fuse on 3700 was also undersized: Should be 30A fuse instead of 20A. Replaced with 30A fuse.

ESC TEST RUN NO. 49 DATE 7-1-74

RUN TIME: START 09:40 WEATHER CONDITION: WIND VEL 15 mph

STOP 5:15 DIRECTION NNW

MILES RECORDED 33 AMBIENT AIR TEMPERATURE 99
1,1,1,1

TEST PERSONNEL:

TEST CONTROLLER R. Begier

CHIEF TEST ENGINEER G. McClure

SAFETY ENGINEER G. Spons

VEHICLE OPERATOR Smith, Tate, Leaston, Beemle

INSTRUMENTATION Barnes

REAR MONITOR

GROUND CONTROLLER

ADDITIONAL PERSONNEL Lewis, McCarty

TEST PROGRAM SPECIFICATION NO. 73-9373

TEST PROCEDURE NO. 4.3 ESC-P-2001-TT

TEST TITLE Performance Verification-Max. wt. Accel, Decel Test

VEHICLE CONFIGURATION 2 cars-max wt.

TEST DESCRIPTION Perform Accel and Decel Tests per Test Plan; reel 20.

COMMENTS Gas generator set hard to start. rope broke. took 2 hrs to repair. Successfully completed conditioning run without any problems. Successfully completed accel test. max wt. Order of Runs listed on back side of paper-ref: Driving from 3701 max wt - max accel = 2.5 Fwd, 2.41 Rev. Ran decel test in same order (i.e: 1 Fwd, 1 Rev), Aux gen on 3701 QSD - Wait 5 min and reset O.K.

FSC TEST RUN NO. 49 (Continued)

Found breaker No. 5 in 3700 was tripped. Successfully completed accel tests. Secured for day.

Test 1 - Accel

| | | |
|---|---|---|
| Run 1 | Switching accel - | fwd (ccw) |
| 2 | Switching accel - | rev (cw) |
| 3 | Switching accel - | fwd |
| 4 | Switching accel - | rev |
| 5 | Switching accel - | fwd |
| 6 | Switching accel - | rev |
| 7 | Series accel - | fwd |
| 8 | Series accel - | rev |
| 9 | " " | fwd |
| 10 | " " | rev |
| 11 | " " | fwd |
| 12 | " " | rev |
| 13 | Parallel accel | fwd |
| 14 | " " | rev |
| 15 | " " | fwd |
| 16 | " " | rev |
| 17 | " " | fwd |
| 18 | " " | rev |

Test 2 - Decel

| | | |
|---|---|---|
| Run 1 | 20 psi sap | fwd |
| 2 | | rev |
| ↓ | | ↓ |
| Run 10 | F.S. Brake Sap | Rev. |

NOTE: Found breaker No. 5 trip due to lead for LOM signal into O-graph had overheated. Removed lead from Lom card.

ESC TEST RUN NO. 50 DATE 7-2-74

RUN TIME: START 10:00 WEATHER CONDITION: WIND VEL 15+

STOP 4:30 DIRECTION

MILES RECORDED 30 AMBIENT AIR TEMPERATURE

TEST PERSONNEL:

TEST CONTROLLER R. Begier

CHIEF TEST ENGINEER G. McClure

SAFETY ENGINEER G. Spons

VEHICLE OPERATOR Smith, Tate, Leaston, Beemler

INSTRUMENTATION Barnes

REAR MONITOR

GROUND CONTROLLER

ADDITIONAL PERSONNEL McCarty

TEST PROGRAM SPECIFICATION NO. 73-9373 GSP-064

TEST PROCEDURE NO. 4.3 ESC-PN-1301-TT

TEST TITLE Performance Verification - Noise Level Tests

VEHICLE CONFIGURATION 2 cars-max wt.

TEST DESCRIPTION Perform tests per Test Plan

COMMENTS Completed paras. A. B, and C of Interior Noise Test. Could not perform exterior test due to high wind effects. During Run D of Interior Noise Test, Aux. gen QSD - reset O.K. but noticed smell coming from underside of car. Investigation revealed T1 volt trap flashed and wires burned. Went to barn to investigate. Investigation revealed flashed VT1 volt trap caused by loss of diode D116. Replaced diode with higher rated - now have complete set of replacement diodes in 3701.

ESC TEST RUN NO. 51 DATE 7-11-74

RUN TIME: START 6:45 WEATHER CONDITION: WIND VEL

STOP 3:00 DIRECTION

MILES RECORDED 30 AMBIENT AIR TEMPERATURE

TEST PERSONNEL:

TEST CONTROLLER R. Begier

CHIEF TEST ENGINEER G. McClure

SAFETY ENGINEER G. Spons

VEHICLE OPERATOR Smith, Tate, Leaston, Beemler

INSTRUMENTATION

REAR MONITOR

GROUND CONTROLLER

ADDITIONAL PERSONNEL McCarty, Luggett

TEST PROGRAM SPECIFICATION NO. 73-9373, GSP-064

TEST PROCEDURE NO. 4.3 ESC-CN-0001-TT

TEST TITLE Performance Verification-Noise Level

VEHICLE CONFIGURATION 2 cars-max. wt.

TEST DESCRIPTION Perform Noise Level Test per Test Plan

COMMENTS Completed Cond. run. Completed exterior noise test - 50' from rail. Experienced aux. gen. QSD's from 3701. Placed monitor on 3700 to check oper. integrity. B & K unit was on tripod in car and leg of tripod collapsed. Mike was broken. Borrowed TSC's. Will run exterior noise & interior noise in A.M. Gas gen set dropped power - Brush lead shorted.

ESC TEST RUN NO. 52 DATE 7-12-74

RUN TIME: START 09:30 WEATHER CONDITION: WIND VEL

STOP 2:00 DIRECTION

MILES RECORDED 30 AMBIENT AIR TEMPERATURE

TEST PERSONNEL:

TEST CONTROLLER R. Begier

CHIEF TEST ENGINEER G. McClure

SAFETY ENGINEER G. Spons

VEHICLE OPERATOR Smith, Tate, Leaston, Beemler

INSTRUMENTATION Barnes

REAR MONITOR

GROUND CONTROLLER

ADDITIONAL PERSONNEL McCarty, Luggett

TEST PROGRAM SPECIFICATION NO. 73-9373 & GSP-064

TEST PROCEDURE NO. Performance Verification-Noise Level ESC-CN-0001-TT

TEST TITLE Noise Level Tests - ext and int.

VEHICLE CONFIGURATION 2 cars - Max wt.

TEST DESCRIPTION Perform tests per above documents

COMMENTS Aux. gen. problem not in logic on 3701. Circuit is external & FAR and/or CFR is tripping out. Collin suggests that 32 vdc side of X-former be disconnected from logic since it is a signal only to FCD. Collin gave both cars clean bill of health for logic system. 3701 has only slight oscillation at brake - he will fix later.

ESC TEST RUN NO 52 (Continued)

3700 F/W No. 2 (SNA):

Noticed Thursday, 7-11-74, that noise from G/B area was becoming quite audible. Vibration was set up in floor. During 2 hr run, noise and vibration was becoming more apparent. Shut down to investigate. On Friday 7-12-74 ran spl on F/W (see attached sheet). Decided not to run car. Will remove F/W and send to Torr. for investigation. They are sending spare unit up.

ESC TEST RUN NO. 53 DATE 7-17-74

RUN TIME: START 08:48 WEATHER CONDITION: WIND VEL

STOP 3:00 DIRECTION

MILES RECORDED 30 AMBIENT AIR TEMPERATURE

TEST PERSONNEL:

TEST CONTROLLER R. Begier

CHIEF TEST ENGINEER G. McClure

SAFETY ENGINEER G. Spons

VEHICLE OPERATOR Smith, Tate, Leaston, Beemler

INSTRUMENTATION Barnes

REAR MONITOR

GROUND CONTROLLER

ADDITIONAL PERSONNEL McCarty

TEST PROGRAM SPECIFICATION NO. GSP-064

TEST PROCEDURE NO. ESC-CN-0001-TT, ESC-PN-2001-TT, and ESC-PN-3001-TT

TEST TITLE Exterior Noise Level, Accel & Decel Effect on car

VEHICLE CONFIGURATION 2 cars - AW3

TEST DESCRIPTION Perform tests per test plan.

COMMENTS Successfully completed exterior noise test (1st half) and accel & decel effect on car. Experienced loss of fan power infrequently on 3701. Had disconnected 32 vdc from Xformer, but still have loss of fan. Will investigate regulator as a possible cause.

ESC TEST RUN NO. 54 DATE 7-18-74

RUN TIME: START 09:30 WEATHER CONDITION: WIND VEL

STOP 4:00 DIRECTION

MILES RECORDED 45 AMBIENT AIR TEMPERATURE

TEST PERSONNEL:

TEST CONTROLLER R. Begier

CHIEF TEST ENGINEER G. McClure

SAFETY ENGINEER G. Spons

VEHICLE OPERATOR Smith, Tate, Leaston, Beemler

INSTRUMENTATION Barnes

REAR MONITOR

GROUND CONTROLLER

ADDITIONAL PERSONNEL McCarty, Nickel, Raskin, Rabe, Bowler, Augiuado, Blakely

TEST PROGRAM SPECIFICATION NO. GSP-064

TEST PROCEDURE NO. ESC-CN-0001, and ESC-P-3002-TT

TEST TITLE Exterior Noise test (Platform), Friction Brake Decel

VEHICLE CONFIGURATION 2 cars - AW3

TEST DESCRIPTION Perform tests per test plan. De-ballast cars to AW2 in P.M. Reel 21.

COMMENTS Successfully completed ext. noise test. Platform completed AW3 decel service friction at 45 psi and 25 psi set, 15, 30 and 40 mph. Experienced F/W T/L QSD on both cars in A.M. No QSD in P.M. Did not experience fan loss in 3701 all day. Gave demo. to Art Raabe and Dan Raskin- deballast to AW2 (30,800 lbs) in P.M.

ESC TEST RUN NO. 55 DATE 7-19-74

RUN TIME: START 10:00 WEATHER CONDITION: WIND VEL

STOP 12:00 DIRECTION

MILES RECORDED 20 AMBIENT AIR TEMPERATURE

TEST PERSONNEL:

TEST CONTROLLER R. Begier

CHIEF TEST ENGINEER G. McClure

SAFETY ENGINEER G. Spons

VEHICLE OPERATOR Smith, Tate, Leaston, Beemler

INSTRUMENTATION Barnes

REAR MONITOR

GROUND CONTROLLER

ADDITIONAL PERSONNEL McCarty

TEST PROGRAM SPECIFICATION NO. GSP-064

TEST PROCEDURE NO. ESC-P-3002-TT, ESC-P-3001-TT, and ESC-P-2001-TT

TEST TITLE Decel Service Friction (AW2), Decel B.B., Accel

VEHICLE CONFIGURATION 2 cars - AW2

TEST DESCRIPTION Perform tests per test plan; reel 21

COMMENTS Began AW2 decel service friction test. Completed Run #8. Initiated Run 9 when 3700 had aux. gen. QSD & much noise and vibration coming from F/W #1. Visual inspection on coastdown revealed noise (thrashing) coming from rear flange of F/W section. Vibration began to decrease from rear to fwd flange. Went to barn.

ESC TEST RUN NO. 67 DATE 12-18-74

RUN TIME: START 08:00 WEATHER CONDITION: WIND VEL

STOP 2:00 DIRECTION

MILES RECORDED 45 AMBIENT AIR TEMPERATURE

TEST PERSONNEL:

TEST CONTROLLER R. Begier

CHIEF TEST ENGINEER G. McClure

SAFETY ENGINEER G.Spons

VEHICLE OPERATOR Smith, Tate

INSTRUMENTATION Mccommon

REAR MONITOR

GROUND CONTROLLER As required

ADDITIONAL PERSONNEL McCarty

TEST PROGRAM SPECIFICATION NO. GSP-064

TEST PROCEDURE NO. ESC-P-3001-TT and ESC-P-3002-TT

TEST TITLE Decel blended braking, Decel service friction

VEHICLE CONFIGURATION 2 cars-AW0

TEST DESCRIPTION Perform tests per GSP-064

Reel 23

COMMENTS Successfully completed accel blended brake and decel service fric tion at AW0. No problems experienced during test day.

ESC TEST RUN NO. 71 DATE 1-7-75

RUN TIME: START 08:00 WEATHER CONDITION: WIND VEL 0

STOP 4:00 DIRECTION

MILES RECORDED 40 40 AMBIENT AIR TEMPERATURE

TEST PERSONNEL:

TEST CONTROLLER G. McClure

CHIEF TEST ENGINEER R. Begier

SAFETY ENGINEER G. Spons

VEHICLE OPERATOR

INSTRUMENTATION Mccommon

REAR MONITOR Yes

GROUND CONTROLLER As required

ADDITIONAL PERSONNEL McCarty

TEST PROGRAM SPECIFICATION NO. GSP-064

TEST PROCEDURE NO. ESC-P-4001-TT and ESC-PN-1301-TT

TEST TITLE Drift Test and Interior Noise Survey

VEHICLE CONFIGURATION 2 cars-AWO

TEST DESCRIPTION Perform per test plan; reel 23

COMMENTS Successfully completed drift test - AWO. Zero wind velocity. Changed R8 on 203 Brd from 75K to 150K - Both cars - no change in accel. Changed 3700 203, R8 from 100-150. Due to 3700 speed vs T/M curr higher than 3701. Noticed 1 mph dec in speed vs time. Changed R4 on 207 Brd from 75-100K. When R8 on 203 was increased to 150K, 3700 3rd rail fell off at 5 amp point with 3701- No longer stays on 3 to 5 sec more.

ESC TEST RUN NO. 72 DATE 1-8-75

RUN TIME: START 09:30 WEATHER CONDITION: WIND VEL 0

STOP 5:00 DIRECTION

MILES RECORDED 75 AMBIENT AIR TEMPERATURE 35

TEST PERSONNEL:

TEST CONTROLLER R. Begier

CHIEF TEST ENGINEER G. McClure

SAFETY ENGINEER G. Spons

VEHICLE OPERATOR

INSTRUMENTATION Mccommon

REAR MONITOR Yes

GROUND CONTROLLER As required

ADDITIONAL PERSONNEL McCarty, Couvillon

TEST PROGRAM SPECIFICATION NO. GSP-064

TEST PROCEDURE NO. ESC-PN-1301-TT

TEST TITLE Interior Noise Survey, Accel and Decel & effect, Effect of track on car

VEHICLE CONFIGURATION 2 cars -AW0

TEST DESCRIPTION Perform tests per test plan; reel 23

Reel 8, 9, and 10 - Small recorder

COMMENTS Successfully completed 73-9373 interior noise survey and GSP-064 interior noise survey. Also completed accel and decel effect on car and effect of track section on car, All at AW0. No problems experienced during test day.

ESC TEST RUN NO. 73 DATE 1-9-75

RUN TIME: START 09:00 WEATHER CONDITION: WIND VEL 15-25

STOP 4:00 DIRECTION N-S

MILES RECORDED 90 AMBIENT AIR TEMPERATURE 20

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TEST PERSONNEL:

TEST CONTROLLER W. Myer

CHIEF TEST ENGINEER G. McClure

SAFETY ENGINEER G. Spons

VEHICLE OPERATOR

INSTRUMENTATION Mccommon

REAR MONITOR as required

GROUND CONTROLLER as required

ADDITIONAL PERSONNEL McCarty, Convillion

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TEST PROGRAM SPECIFICATION NO. GSP-064

TEST PROCEDURE NO. ESC-R-0010; R-2001; R-3001; R-1101

TEST TITLE Ride Roughness - Component Induced Vibration, Accel & Decel, Worst speed

VEHICLE CONFIGURATION 2 cars - AWO

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TEST DESCRIPTION Perform tests per test plan; reel 23

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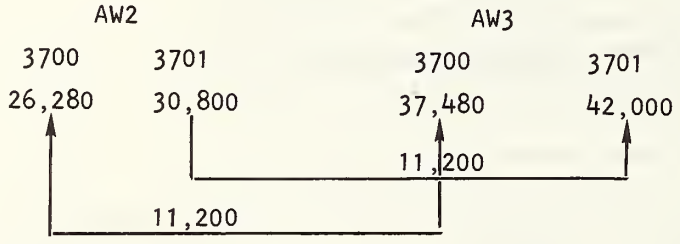
COMMENTS Successfully completed ride roughness tests of component induced vibration, worst speeds (Selected 20, 35 & 45 since no major indication of worst car speed) and accel & decel. No problems experienced during day. AWO complete except accel & power consumption. Weighed cars at end of day:

| | No. 1 end | No. 2 end | Total |
|---|---|---|---|
| 3701 = | 42260 | 40560 | 82820 |
| 3700 = | 43840 | 41200 | 85040 |
| | | | A = 2220 |

ESC TEST RUN NO' 73 (Continued)

| AW0 | | AW2 | AW3 |
|---|---|---|---|
| 3701 = | 82820 | 113620 | 124820 |
| 3700 = | 82320 | 113120 | 124320 |
| | +1800 = | people (9 @ 200 ea) | |
| | +2700 = | Instr'n & equipment on car | |
| | 86840 | | |

Ballast Req'd:



ESC TEST RUN NO. 74 DATE 1-13-75

RUN TIME: START 08:30 WEATHER CONDITION: WIND VEL

STOP 11:30 DIRECTION

MILES RECORDED 0 AMBIENT AIR TEMPERATURE

TEST PERSONNEL:

TEST CONTROLLER W. Myer

CHIEF TEST ENGINEER G. McClure

SAFETY ENGINEER G. Spons

VEHICLE OPERATOR

INSTRUMENTATION Sessions

REAR MONITOR as required

GROUND CONTROLLER as required

ADDITIONAL PERSONNEL McCarty, Couvillion, Mcconnel

TEST PROGRAM SPECIFICATION NO. GSP-064

TEST PROCEDURE NO. ESC-R-1101-TT

TEST TITLE Ride Roughness, Drift

VEHICLE CONFIGURATION 2 cars - AW2

TEST DESCRIPTION Perform tests per test plan. Weigh cars at AW2.

| AW2 Wts: | Truck 1 | Truck 2 | Total |
|---|---|---|---|
| 3701 = | 59000 | 56360 = | 115360 |
| 3700 = | 56140 | 50900 = | 107040 |

COMMENTS Correction:

1 - remove 1740 lbs from 3701, Truck 1

2 - Add 4280 lbs 3700, Truck 2

No test run today Pot 1 power supply wires shorted and need repair.

ESC TEST RUN NO. 75 DATE 1-14-75

RUN TIME: START 2:00 WEATHER CONDITION: WIND VEL

STOP 5:00 DIRECTION

MILES RECORDED 45 AMBIENT AIR TEMPERATURE

TEST PERSONNEL:

TEST CONTROLLER W. Myer

CHIEF TEST ENGINEER G. McClure

SAFETY ENGINEER G. Spons

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INSTRUMENTATION Sessions

REAR MONITOR Yes

GROUND CONTROLLER as required

ADDITIONAL PERSONNEL McCarty, Couvillion, Mcconnel, Nickel Curran, Huggett

TEST PROGRAM SPECIFICATION NO. GSP-064

TEST PROCEDURE NO. ESC-R-1101-TT

TEST TITLE Ride Roughness and Drift - AW2

VEHICLE CONFIGURATION 2 cars - AW2

TEST DESCRIPTION Perform tests per test plan; reel 24

COMMENTS Successfully completed ride roughness at AW2. Performed accel & decels in level tangent. Calibrated motor speed for car vs 9th wheel: Must rerun @ constant speeds. Investigation revealed that variable load reostat was set low for AW2; re-adjusted for proper output resistance at AW2.

ESC TEST RUN NO. 76 DATE 1-15-75

RUN TIME: START 08:30 WEATHER CONDITION: WIND VEL

STOP 5:00 DIRECTION

MILES RECORDED 70 AMBIENT AIR TEMPERATURE

TEST PERSONNEL:

TEST CONTROLLER W. Myer

CHIEF TEST ENGINEER G. McClure

SAFETY ENGINEER G. Spons

VEHICLE OPERATOR

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REAR MONITOR

GROUND CONTROLLER as required

ADDITIONAL PERSONNEL McCarty, Huggett, Couvillion, Nickel, Mcconnel, Curran

TEST PROGRAM SPECIFICATION NO. GSP-064

TEST PROCEDURE NO. ESC-P-4001-TT

TEST TITLE Drift, decel service friction, Decel blended brake

VEHICLE CONFIGURATION 2 cars - AW2

TEST DESCRIPTION Perform tests per test plan; reel 24

COMMENTS Successfully completed drift test @ AW2, decel blended brake and decal service friction. Ran accel and decel in level tangent with and without friction brake. Ran 1 Lap of power consumption at AW2 = 88.2 Kwh/Lap. No problems experienced during test day.

ESC TEST RUN NO. 77 DATE 1-16-75

RUN TIME: START 08:30 WEATHER CONDITION: WIND VEL 0

STOP 3:30 DIRECTION

MILES RECORDED 70 AMBIENT AIR TEMPERATURE

TEST PERSONNEL:

TEST CONTROLLER W. Myer

CHIEF TEST ENGINEER G. McClure

SAFETY ENGINEER G. Spons

VEHICLE OPERATOR Tate

INSTRUMENTATION Sessions

REAR MONITOR Lennesy

GROUND CONTROLLER

ADDITIONAL PERSONNEL Huggett, Nickel, Mcconnel, Curran

TEST PROGRAM SPECIFICATION NO. GSP-064

TEST PROCEDURE NO. ESC-P-5001-TT

TEST TITLE Friction Brake Duty Cycle, Accel

VEHICLE CONFIGURATION 2 cars - AW2

TEST DESCRIPTION Perform tests per test plan; reel 24

COMMENTS Successfully completed friction brake duty cycle: Ran 1 lap at 30 mph, 45 sec cruise, 30 sec stop while recording temps @ stop. Ran in L. Tanjent fwd and rev for 1/2 hr at 45 mph, 55 sec cruise, etc. Completed accel, fwd and rev in L.T. Ran accels and decels for Bob, drift fwd and ran with and without inshot and 1 Lap of 10,000', 45 mph, 30 sec stop, CW. KwL/Lap = 67. Ballest cars to AW3.

ESC TEST RUN NO. 77 (Continued)

AW3

| 3700 | | 3701 | |
|---|---|---|---|
| Truck 1 | Truck 2 | Truck 1 | Truck 2 |
| 60,900 | 61,000 | 62,520 | 61,760 |
| Total 121,900 lbs | | Total = 124,280 lbs | |
| +620 | | +600 | |

3701:
+600 Truck 1
3700:
Truck 1 = 310
Truck 2 = 310

ESC TEST RUN NO. 78 DATE 1-17-75

RUN TIME: START 08:30 WEATHER CONDITION: WIND VEL

STOP 5:00 DIRECTION

MILES RECORDED 100 AMBIENT AIR TEMPERATURE

TEST PERSONNEL:

TEST CONTROLLER W. Myer

CHIEF TEST ENGINEER G. McClure

SAFETY ENGINEER G. Spons

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REAR MONITOR

GROUND CONTROLLER

ADDITIONAL PERSONNEL Huggett

TEST PROGRAM SPECIFICATION NO. GSP-064

TEST PROCEDURE NO. ESC-PC-5011-TT, ESC-R-2001-TT

TEST TITLE Accel, Decel, Power Cons., Ride Roughness

VEHICLE CONFIGURATION 2 cars - AW3

TEST DESCRIPTION Perform tests per test plan; reel 25

COMMENTS Successfully completed accel, decel, and power consumption at AW3. No problems experienced.

ESC TEST RUN NO. 79 DATE 1-20-75

RUN TIME: START 08:30 WEATHER CONDITION: WIND VEL

STOP 12:00 DIRECTION

MILES RECORDED 45 AMBIENT AIR TEMPERATURE

TEST PERSONNEL:

TEST CONTROLLER W. Myer

CHIEF TEST ENGINEER G. McClure

SAFETY ENGINEER G. Spons

VEHICLE OPERATOR

INSTRUMENTATION Sessions

REAR MONITOR

GROUND CONTROLLER

ADDITIONAL PERSONNEL McCarty, Huggett, Convillion, Henst

TEST PROGRAM SPECIFICATION NO. GSP-064

TEST PROCEDURE NO. ESC-R-1101-TT

TEST TITLE Ride Roughness

VEHICLE CONFIGURATION 2 cars AW3

TEST DESCRIPTION Perform test per test plan; reel 26

COMMENTS Successfully completed ride roughness. Went in to barn to install T/M power cons. instr'n and hall effect current sensors.

ESC TEST RUN NO. 80 DATE 1-21-75

RUN TIME: START 9:00 WEATHER CONDITION: WIND VEL

STOP 5:00 DIRECTION

MILES RECORDED 64 AMBIENT AIR TEMPERATURE

TEST PERSONNEL:

TEST CONTROLLER R. Begier

CHIEF TEST ENGINEER G. McClure

SAFETY ENGINEER G. Spons

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REAR MONITOR

GROUND CONTROLLER

ADDITIONAL PERSONNEL Huggett, Wienstien

TEST PROGRAM SPECIFICATION NO. GSP-064

TEST PROCEDURE NO. ESC-PSI-6001-TT

TEST TITLE EMI

VEHICLE CONFIGURATION 2 cars - AWO

TEST DESCRIPTION

COMMENTS Ran 1 lap fwd & Rev @ 3000 , 30 sec 45 mph with T/M and 3rd rail on Kwh meters at AWO. No change in Kwh/Lap however, T/M can = 24% higher with 10% added to reading for motor and chopper efficiency. Recal instr'n. and set up for shunts vs haul effects.

ESC TEST RUN NO. 81 DATE 1-22-75

RUN TIME: START 08:30 WEATHER CONDITION: WIND VEL

STOP 4:30 DIRECTION

MILES RECORDED 60 AMBIENT AIR TEMPERATURE

TEST PERSONNEL:

TEST CONTROLLER W. Myer

CHIEF TEST ENGINEER G. McClure

SAFETY ENGINEER G. Spons

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REAR MONITOR

GROUND CONTROLLER

ADDITIONAL PERSONNEL Henst, Wienstien

TEST PROGRAM SPECIFICATION NO. GSP-064

TEST PROCEDURE NO. ESC-PSI-6001-TT

TEST TITLE Duty cycles and EMI

VEHICLE CONFIGURATION 2 cars - AWO

TEST DESCRIPTION

COMMENTS Ran duty cycles all day. Results: car 3701 runs at 3.92 Kwh/CM and T/M's are matched to within 2% of energy consumed. Car 3701 runs at 5.19 Kwh/CM and T/M's are matched to within 1% of energy consumed. Must run accel and reduce speed schedule for arm current reduction. Ran laps with and without inshot-NO appreciable difference.

ESC TEST RUN NO. 82 DATE 1-23-75

RUN TIME: START 09:00 WEATHER CONDITION: WIND VEL

STOP 1700 DIRECTION

MILES RECORDED 30 AMBIENT AIR TEMPERATURE

Reliability time = 3 hrs 30 min

TEST PERSONNEL:

TEST CONTROLLER W. Myer

CHIEF TEST ENGINEER G. McClure

SAFETY ENGINEER G. Spons

VEHICLE OPERATOR

INSTRUMENTATION Sessions

REAR MONITOR

GROUND CONTROLLER

ADDITIONAL PERSONNEL Henst, Wienstien, Yutko

TEST PROGRAM SPECIFICATION NO. GSP-064

TEST PROCEDURE NO. ESC-PSI-6001-TT

TEST TITLE EMI and Reliability, Accel and AW0

VEHICLE CONFIGURATION 2 cars - AW0

TEST DESCRIPTION ~~Run per test~~ plans; reel 26

COMMENTS Ran accel at AW0, FWD and REV. Gave accel and decel data to Charlie for AW0 and AW3. Accel and decel schedule for both are low. Car 3700 pulling more T/M current than 3701 = 25A higher. Successfully completed constant speed runs at 45, 18 and 12 mph for EMI.

ESC TEST RUN NO. 83 DATE 1-24-75

RUN TIME: START _____ WEATHER CONDITION: WIND VEL _____

STOP _____ DIRECTION _____

MILES RECORDED _____ AMBIENT AIR TEMPERATURE _____

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TEST PERSONNEL:

TEST CONTROLLER _____

CHIEF TEST ENGINEER McClure

SAFETY ENGINEER _____

VEHICLE OPERATOR _____

INSTRUMENTATION _____

REAR MONITOR _____

GROUND CONTROLLER _____

ADDITIONAL PERSONNEL _____

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TEST PROGRAM SPECIFICATION NO. GSP-064

TEST PROCEDURE NO. ESC-R-0001-XX

TEST TITLE Dynamic Shake Test and Pull Test at AWO

VEHICLE CONFIGURATION AWO Car 3700

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TEST DESCRIPTION Perform test per test plan; reels 26 and 27

COMMENTS Performed Pull Test on cars
3701 - 300 @ No. 1 end and 280 No. 2 end.
3700 - 160 @ No. 1 end and 280 No. 2 end.
All data for Dyn. Shake Test is recorded on tape, O'graph and instruction Log Book. Performed vertical, longitudinal and vertical torsion @ AWO - Could not do lateral due to lack of mounting fixture. Test data follows test Log No. 86.

ESC TEST RUN NO. 84-85 DATE 1-25-75

RUN TIME: START _____ WEATHER CONDITION: WIND VEL _____

STOP _____ DIRECTION _____

MILES RECORDED _____ AMBIENT AIR TEMPERATURE _____

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TEST PERSONNEL:

TEST CONTROLLER _____

CHIEF TEST ENGINEER G. McClure

SAFETY ENGINEER _____

VEHICLE OPERATOR _____

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REAR MONITOR _____

GROUND CONTROLLER _____

ADDITIONAL PERSONNEL _____

---

TEST PROGRAM SPECIFICATION NO. GSP-064

TEST PROCEDURE NO. ESC-R-0001-XX

TEST TITLE Dynamic Shake Test - AW2

VEHICLE CONFIGURATION _____

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TEST DESCRIPTION Reel 27

COMMENTS Successfully completed Dynamic Shake Test vertical, longitudinal and vertical torsion at AW2 and began AW3. Test data follows test log No. 86.

ESC TEST RUN NO. 86 DATE 1-26-75

RUN TIME: START _____ WEATHER CONDITION: WIND VEL _____

STOP _____ DIRECTION _____

MILES RECORDED _____ AMBIENT AIR TEMPERATURE _____

---

TEST PERSONNEL:

TEST CONTROLLER _____

CHIEF TEST ENGINEER G. McClure

SAFETY ENGINEER _____

VEHICLE OPERATOR _____

INSTRUMENTATION Sessions, Mcconnon

REAR MONITOR _____

GROUND CONTROLLER _____

ADDITIONAL PERSONNEL _____

---

TEST PROGRAM SPECIFICATION NO. GSP-064

TEST PROCEDURE NO. ESC-R-0001-XX

TEST TITLE Dynamic shake test at AW3

VEHICLE CONFIGURATION _____

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TEST DESCRIPTION Reel 27

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COMMENTS Successfully completed vertical, longitudinal and vert. torsion (17" offset) at AW3. Calibrated suitcase for Monday.

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ESC TEST RUN NO. 87 DATE 1-27-75

RUN TIME: START 10:00 WEATHER CONDITION: WIND VEL

STOP 5:00 DIRECTION

MILES RECORDED 50 AMBIENT AIR TEMPERATURE

Reliability Run Time = 4 hrs, 45 min.

TEST PERSONNEL:

TEST CONTROLLER W. Myer

CHIEF TEST ENGINEER G. McClure

SAFETY ENGINEER G. Spons

VEHICLE OPERATOR

INSTRUMENTATION Mcconnon

REAR MONITOR

GROUND CONTROLLER

ADDITIONAL PERSONNEL Yutko

TEST PROGRAM SPECIFICATION NO. GSP-064

TEST PROCEDURE NO. ESC-PSI-6001-TT

TEST TITLE EMI and Reliability

VEHICLE CONFIGURATION 2 cars, AW3

TEST DESCRIPTION

COMMENTS Successfully completed EMI testing. During below base speed accels, fuses blew in EMI equipment and only could record freq. above 25. Re-entered reliability running. Checked out both sides of suitcase by swapping 3rd rail from 3700 from right to left for same 2 runs = 0.2 KWH A. Completed 3700 T/M input and output test.

## GLOSSARY

| | |
|---|---|
| Ampl vs Freq plot | Log-log plot or semi-log plot of data |
| AW0 | Vehicle empty weight |
| AW2 | Vehicle empty weight plus full load |
| AW3 | Vehicle empty weight plus crush load |
| CB | Carbody |
| DOT | Department of Transportation |
| ESC | Energy storage car |
| ESS | Energy storage system |
| FWD | Forward |
| F.S. | Full scale |
| F/W | Flywheel |
| H.P. | Hewlett Packard |
| MTA | Metropolitan Transportation Agency |
| NA | Not applicable |
| NYCTA | New York City Transit Authority |
| PAR | Parallel |
| QSD | Quick shutdown |
| REV | Reverse |
| RQD | Required |
| SER | Series |
| SW | Switch |
| TSC | Transportation Systems Center |
| TTC | Transportation Test Center |
| T/M | Traction motor |
| UMTA | Urban Mass Transportation Administration |
| X-Y Plot | Graphical data presentation obtained by running analog magnetic tape into an X-Y plotter with minimum filtering. |



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